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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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GEOLOGICAL SURVEY MAPS IN THE MAKING: A TRANSIT STATION ON THE IDAHO-MONTANA BOUNDARY.—[See page 165]

Scientific American Publishing Co., Munn & Co., New York

The Makers of U.S. Royal Cords *Beg to State —*

NOT quite seven years ago the U. S. Royal Cord Tire was announced to the public.

People who saw it remarked on the beauty of the tread design, which is protected by U. S. Letters Patent.

The same design that since then has proved itself the most scientific tread pattern ever put on a pneumatic tire.

To identify this superlative tire under all conditions—whether running or stationary—Royal Cord makers adopted as a trade mark a circumferential *white stripe* placed on each sidewall.

Today, Royal Cord beauty and identity is so known and distinguished that even a newsboy can spot one whisking around the corner.

And car-owners everywhere look upon a Royal Cord as the measure of *all* automobile tire values.

* * *

According to some tire dealers and manufacturers the public has been having one of its "price spells" and demands cheap tires.

This is contrary to the facts.

Otherwise Royal Cords wouldn't keep gaining and gaining and gaining in sales to *quality people.*

And—you wouldn't see Royal Cords on so many cars of every make in the country.

Nor—if Americans were on record for cheaply made and cheaply priced tires—would they award the leadership of the tire business to the Royal Cord Tire.

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United States Tires are Good Tires

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United States (US) Rubber Company

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Combining these factors in the same truck is one of the Seven Steps Ahead by which GMC trucks insure better haulage

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Division of General Motors Corporation

1 ton, $1295; 2 ton, $2375; 3½ ton, $3600; 5 ton, $3950; chassis only, at the factory; tax to be added.

General Motors Trucks

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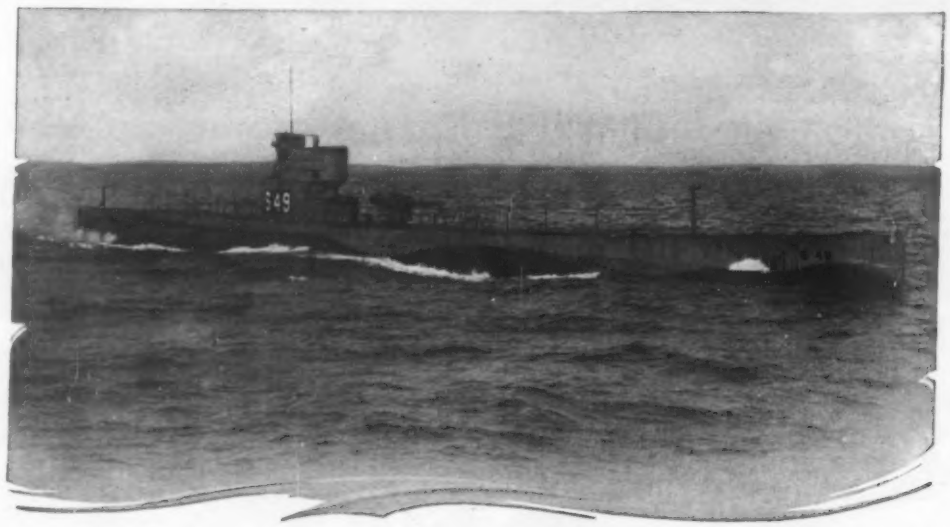

Ball Bearings Guard the Safety
of Submarines While Submerged

THE vital parts upon which the safety of the crew depends when the submarine is submerged are the main motors which drive the vessel and the auxiliary motors that operate the pumps. If these motors fail serious consequences may result.

For this exacting duty where positive performance at all times is the paramount requisite, motors equipped with SKF marked self-aligning ball bearings are used.

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BALL BEARINGS

The Highest Expression of the Bearing Principle

Henry M. Utley Branch

With the Editors

WE are always glad to hear from our readers. Indeed, nothing gives us a greater thrill than to receive word from you as to how you like the SCIENTIFIC AMERICAN, what you are interested in, suggestions as to how the journal might be improved upon, what is taking place in your vicinity or in your line of work, and so on. Write to us, both early and often. Your letters serve as our barometer of reader interest. Being unable to go out among our readers and speak to them in person, we depend on the good offices of the United States Mail to establish an intimate touch with you by the printed and the typewritten and the handwritten word.

OUR good friend A. I. Root of Medina, Ohio, has the right idea. But why shouldn't he? Being an editor for the past fifty years, he knows how much the usual editor desires to hear from his readers. Under date of July 8, our good friend Root writes to us as follows: "Perhaps you may recall that I am the chap that has been reading the SCIENTIFIC AMERICAN since Volume 1, Number 1. I am eighty-two years old. I was only five years old when the first number of the SCIENTIFIC AMERICAN came out, but when I was ten years old, I was so much interested that I borrowed the back numbers and read it through thoroly from Volume 1 up, and I have read it more or less thoroly all these years." By the way, Mr. Root is the editor and publisher of the little journal, *Gleanings in Bee Culture*, which was started over fifty years ago. He tells us that our journal has always been his right-hand help in matters of science. He quotes us frequently.

AND just as we appealed to Mr. Root when he was a mere lad, so we appeal to the young Americans of the present day. We take pride in our youthful audience. Many of our letters are received from boys, asking us where they can buy tools, model-maker's supplies, radio material, electrical equipment and so on. Our radio inquiries alone are significant, and bulk up large alongside the steady stream of correspondence from various business men and engineers and companies in search of information of the workaday sort.

WHEN we first decided to delve into psychic matters, we fully realized that we were undertaking a great task. This new science—if it really is a science—is so controversial, so full of fraud, that one steps along in a most gingerly manner and with that ever-expectant, uneasy feeling that one's statements or articles may not represent the absolute truth or real facts. We had this feeling brought home to us when we passed on the manuscript from Mr. James Black of Montreal, Canada. The manuscript was set up in type and sent to the press room, so that it would appear in this issue under the caption, "Ectoplasm and Ectoplasm Fakers." Then, to our great uneasiness, we came across a press account of an interview with Dr. Richét, the well-known French psychic investigator, which stated that ectoplasm could not be the result of simple fraud. Were we wrong in the conclusions set forth in the article? To be frank, we spent several uneasy days, feeling that we might be on the wrong side of the fence, after all. Then came a letter from Paris, from our Editor, informing us that the Sorbonne experiments with Eva C., the well-known medium, had convinced the scientists of that distinguished institution that ectoplasm was the result of regurgitation. The experts declare that they saw nothing except a substance that had been produced after prolonged efforts that could only be physiologically described as efforts to vomit and that the substance had no mobility of its own and was swallowed again almost immediately. There was no hint of its assuming any forms whatsoever. "Our experiments," concludes the report, "have yielded results which cannot be regarded as other than entirely negative." So we now recommend to you the article in this issue which, although written prior to the Sorbonne report, brings out the results of a long study of the subject by Mr. Black, and is fully confirmed by the findings of the foremost French scientists. And we feel very much at ease!

BEFORE we forget it, Mr. James Black, our authority on psychic matters, has prepared a most interesting article on spirit photography. He traces the history of this fraudulent form of photography, gives the names, dates and places, and then tells of the present developments in this "art." Mr. Black has worked side by side with spiritualists and honest photographers alike, and has carried out the same effects which are contained in so-called "spirit" photographs. His article, accompanied by several interesting "spirit" photographs, will appear in our October issue.

PLEASE do not feel for a single moment that we are biased in psychic matters. We are after the truth, nothing more or less. If there be more fraud than truth, then our series of articles will be along that line. However, we feel, in fairness to everyone, we should hear from the great protagonists of psychic phenomena. To that end we are inviting the psychic investigators of England, France, and Germany to give us their views. Our correspondents in those countries are now endeavoring to interview these psychic investigators, so that at an early date we may have an opportunity of reviewing the evidence and depositions on the other side of the case.

ONE of the very best stories we have ever published in our seventy-eight years of continuous existence will appear in our October issue and will be concluded in the November issue. It is the story of safes and safe breakers, told by no less an authority than Edward H. Smith. "The fact is I have known every really prominent bank criminal in the country, beginning with Frank James and Cole Younger and coming down to date," writes Mr. Smith in one of his letters to us. He is the author of numerous articles which have appeared in the leading periodicals of this country, always on the same broad and highly interesting subject—crime and its detection. His series, entitled "Con," appeared in our most prominent weekly journal, and aroused exceptional interest throughout the country. In fact, it was that unusual interest which caused us to seek Mr. Smith and solicit something from his prolific pen—or typewriter, to sacrifice poetic form for accuracy. However, Mr. Smith knows the safe business. He has collaborated with safe builders and he has the confidence of the leading safe breakers so that his knowledge covers the defensive and the offensive phases of the safe-building and safe-breaking struggle that is constantly going on. If you like his articles, be sure to tell us so.

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What other tires could have done this?

The Midwest Refining Company recently had a lot of machinery to transport from Casper, Wyoming, to their oil fields at Salt Creek, a distance of about fifty miles. Six pieces of this machinery weighed over thirteen tons each and two weighed slightly over fourteen tons. The one on the truck above weighed 28,450 pounds.

The road over which this machinery had to be hauled was "one of the worst in the Wyoming oil fields, full of ruts and bumps, and at the time was covered with ice and snow."

It seemed impossible for any tires to carry these tremendous loads over such a road but the Midwest people felt that Caterpillars would do the job if any tires could.

The loads were so heavy that the Caterpillars bulged over the flanges fully two inches on each side at the point of contact with the road but in spite of this terrific punishment they finished the job without loosening at the base in a single place. They were cracked to some extent but are still good for many more miles.

No matter what your tire requirements may be, at least you should get acquainted with tires that can accomplish such a feat as this. Let us send you our little booklet "Caterpillar Logic."

Caterpillars are made in sizes suitable for trucks of every type and weight

Kelly-Springfield Tire Co.

GENERAL SALES DEPARTMENT

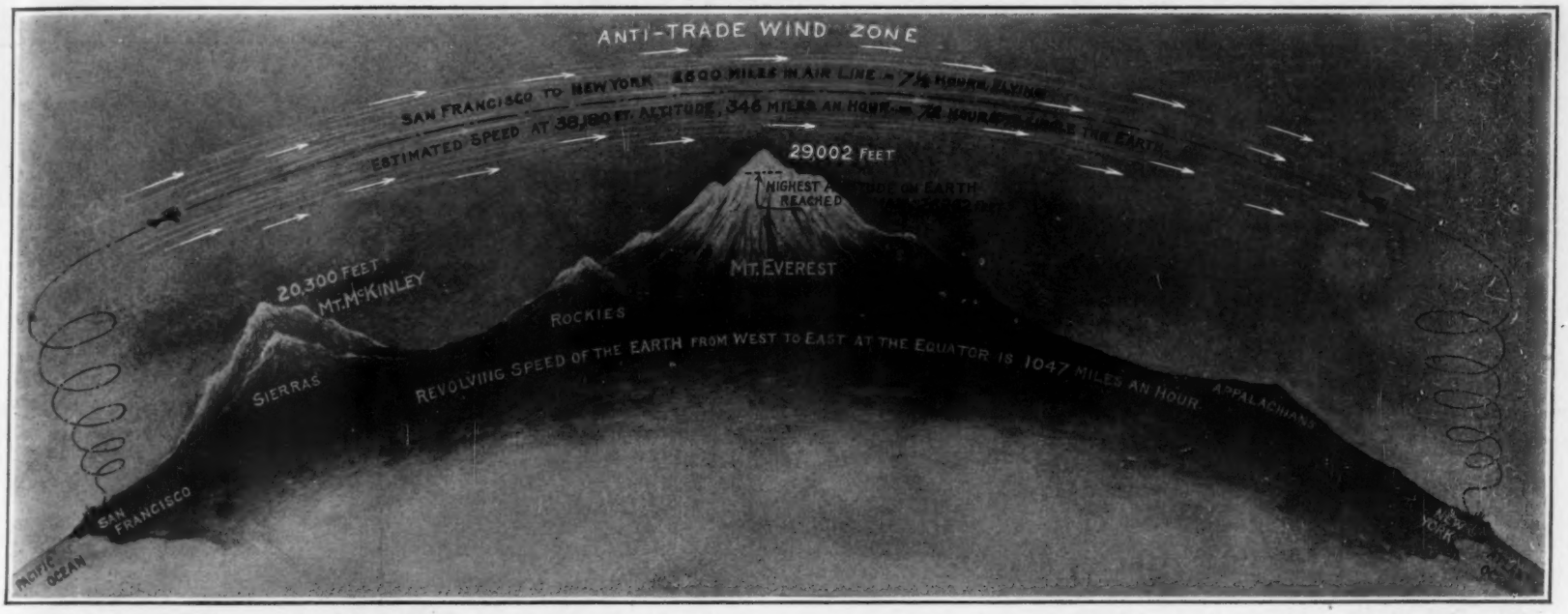
250 West 57th Street NEW YORK, N. Y

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, SEPTEMBER, 1922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SIERRAS
REVOLVING SPEED OF THE EARTH FROM WEST TO EAST AT THE EQUATOR IS 1047 MILES AN HOUR
APPALACHIANS
SAN FRANCISCO
NEW YORK
PACIFIC OCEAN

A graphic demonstration of Major Schroeder's suggestion to utilize the violent west winds prevailing at a seven-mile elevation in speeding up the airplane journey from San Francisco to New York. The artist has taken certain liberties with the location of some of the world's notable peaks for the purpose of showing more vividly the altitude of the proposed flight

Across America in Eight Hours

IF the meteorologist were blessed with a sufficient number of observations of the air to be representative of the upper and the lower strata and of all regions of the globe, he could undertake with some degree of confidence to prepare a scheme showing the average movement of the atmosphere at every point. Such a chart, of course, would deal altogether in averages, and would, at certain times and places, depart widely from the movements actually taking place. But as a compilation of averages it would be correct.

Unfortunately, our recorded observations are notoriously incomplete as regards the mere covering of the earth's whole surface; and as regards the upper layers of the atmosphere they are even more deficient. We do, however, know something about the orderly march of the air, especially for those regions near the surface where that march is most orderly. We know, for instance, that for 20 degrees or more north and south of the equator the wind blows with remarkable steadiness from the east. More precisely, these "trade winds," as they are called, blow from the northeast in the northern hemisphere and from the southeast in the southern.

As youngsters most of us have made the sage remark "Whatever goes up, comes down." In much the same manner we might look at the steady march of the trade winds, blowing from the east, month after month, and conclude that whatever comes west goes east—that is to say, since the wind always blows out of the east in certain quarters of the globe, and since the atmosphere of the earth comprises a definite volume of air, this air must, somewhere, somehow, get back into the east It does not make a complete circuit of the globe, as will be realized on comparing its exact course in the two hemispheres; it really must turn and blow back.

Our geographies tell us of the "anti-trades," as well as of the trade winds; but these, blowing eastward north of the trade-wind zone in the northern hemisphere and south of that zone in the southern hemisphere, are neither steady enough nor speedy enough to keep the trade winds supplied with raw material. So the shrewd suspicion might have been aroused that somewhere in the unexplored upper reaches of the atmosphere east winds of a comparatively high velocity might be found.

Major R. W. Schroeder, who made the first really epoch-marking altitude flight in an airplane, had an experience, flying regularly from McCook Field, Dayton, which is illuminative in this regard. He got up to an altitude of some six miles, and headed his plane due west. He flew for an hour and a half at 100 miles and more per hour, and when he returned to terra firma he landed—200 miles east of Dayton. This indicated a gale from the west of some 300 miles per hour at the altitude in question; and subsequent flights by Major Schroeder and others have verified that this wind always blows, and maintains an average speed of something like 250 miles per hour. By natural extension of the meaning of the term, this constant gale from the west at the seven-mile level has been termed the anti-trade wind, and the region of the atmosphere in which it is to be found the anti-trade zone.

Major Schroeder now comes to the fore with a suggestion that practical use be made of this wind. He would start from San Francisco in an airplane, ascend to the anti-trade zone and head his ship east at all the speed of which it is capable. The air-line distance to New York would be 2600 miles. The most probable value for the average combined speed of wind and plane seems to be 346 miles per hour. At this rate the daring flyer could land in New York in eight hours —if he did not freeze to death en route. Oxygen tanks and all other appurtenances of this extreme high-flying would have to be carried, and the passenger-capacity of a trade-wind plane would be rather cut into by this necessity; nevertheless, if some daring pioneer like Major Schroeder should demonstrate that the thing is possible, we have no doubt that the means of carrying passengers in safety would be forthcoming, and, as well, the passengers to be carried. It would be quite a sensation to breakfast in San Francisco and dine the same evening in New York. Unfortunately, the return trip could hardly be made in the same time.

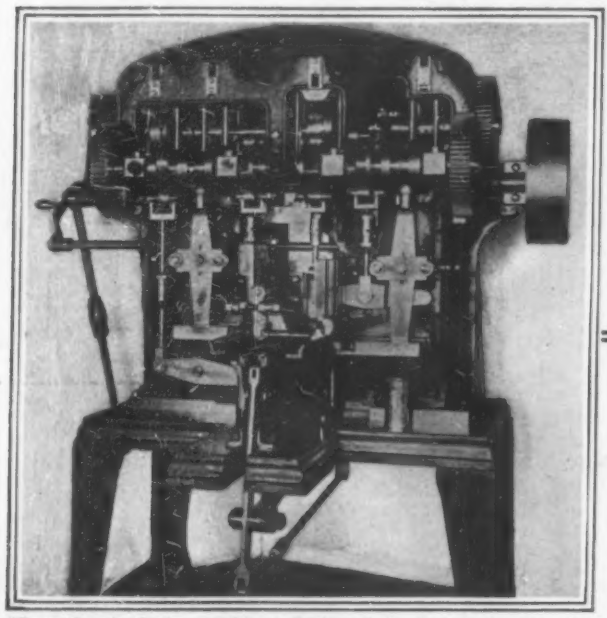
Without going at all into details, an adequate consideration of which would demand far more space than we have to give, we may say in a general way that the persistence of the trade and anti-trade winds is due in part to the heating of our atmosphere by the sun, and in part to effects of the earth's rotation. It is perhaps not altogether superfluous to point out that, save for its effect in working up a wind that blows steadily for one quarter at 250 miles per hour, the earth's rotation plays no part in aviation, and its velocity does not enter into the calculations of the aviator save as an insignificant second-order effect. Whether he stand beside his plane at the starting point, or sit in the cockpit in flight seven miles up, the aviator is part of what Einstein would call the "earth-system," and partakes in its motion. The only effect of his detachment from the surface is that he preserves the surface rotation-component of 1047 miles per hour, carrying this up with him into a zone where the "circumference" is greater and hence the rotation slightly faster. As a matter of fact, at an altitude of seven miles the earth's circumference is about 45 miles greater than at the surface, and the speed of rotation hence about two miles per hour greater. The aviator would therefore, if all other influences were absent, fall only two miles behind (west of) his San Francisco starting point for every hour spent in the air.

Skilled Hands, or Automatic Machinery?

Some Salient Facts Bearing on a Subject of Fundamental Importance in Modern Life

An Interview with Frank M. Leavitt

YOU might search through a dozen great factories today to find a single workman with sufficient mechanical skill to chip, file and hone a mechanically flat surface, or to finish by hand the runway of a lathe. Fifty years ago you might have called upon almost any one of the skilled workmen employed in the metal-working trades to do either of those jobs. In Europe skill of this type is still common, but in America it has almost entirely disappeared.



First tin-can-body machine, designed by Frank M. Leavitt for exhibition at the Paris exposition. It had a capacity of 60 bodies per minute, while its modern descendants turn out 175 in the same time. When this machine was made, only one firm in the world used enough cans to consider its purchase

THE man who is skilled with his hands is fast disappearing from the modern factory, and his place is being taken by a man who watches a machine do the task which once called for expert handling of hand tools. Many of us are inclined to deplore or even to resent the change, and to look back with a sense of loss to the day when craftsmanship was the rule rather than the exception. But is this fair? Numerous of the developments of modern civilization possess such power that, in the wrong hands, they are instruments of crime and oppression. Surely none would give up the automobile because it makes the get-away of a criminal so easy, and his apprehension and identification so hard! Is the automatic machine guilty of all that has been urged against it, or is it in the class with the automobile? Mr. Leavitt, who has produced just about as many of these machines as any single inventor, gives us in the accompanying interview his ideas as to the place which these machines occupy in the march of human progress.—THE EDITOR.

The blame may be placed squarely upon the extensive use of machinery, especially of automatic machinery. Would we ask a workman to produce a mechanically flat surface by hand when a machine can do the job better and in a fraction of the time required for hand work? And why depend on the degree of skill of a mechanic for the accuracy of a lathe runway, when any ordinary machinist can produce a perfect runway in a few minutes on a shaper?

Is there justice then in the oft-repeated charge that the skilled workman is disappearing, to be replaced by a type of workman who is little more than a part of the machine he runs, and whose principal interest in his job is the pay envelop on Saturday night? It is a question of serious importance, one which goes to the very foundation of modern social and economic conditions.

The man to whom we have gone for an opinion has done as much, perhaps, as any other living man to bring about this condition. He has invented scores of the machines in use in industry today, and some of them have been of far-reaching importance. We doubt if it were possible for any person in this country to go through a day without in some way using machines or the product of machines invented by Frank M. Leavitt.

Mr. Leavitt is widely known as the designer of the Bliss-Leavitt torpedo, the type standard with the United States Navy. Largely through the mechanical ability of Mr. Leavitt, the old Whitehead torpedo of a few years ago—an extremely erratic and unreliable mechanism with an effective range of about 800 yards—has become the reliable, accurate modern torpedo with its range of some 15,000 yards. How the torpedo, once laughed at by naval authorities, has become a most effective sea weapon is a matter of very recent record.

In many respects the modern torpedo is one of the most ingenious, complicated and sensitive mechanisms ever devised. But in practical, everyday use this achievement pales into the merest insignificance beside other inventions of Mr. Leavitt, and very few people know his name in connection with them.

He built, for instance, the first automatic tin-can machines, and the importance of this invention can hardly be overestimated. When the first tin-can machine was built there was only one firm in the whole world which used enough tin cans to justify its purchase. That was the Coleman mustard concern in England, and when they refused to purchase it, Mr. Leavitt believed he was "stuck" with the machine. Today an enormous canning and packing industry owes its existence largely to the fact that in the machine-made tin can we have a cheap, strong, air-tight container. Of course, the first tin-can machine, which turned out 60 tin-can bodies a minute, was a crude affair beside the tin-can-body machines of today, which turn out 175 can bodies a minute, and it is hard to find points of similarity between the two, but the latter is the direct descendant of the former.

Another invention which is quite as important as the tin-can machine is the toggle drawing press. This machine has made possible cheap tinware, and all sorts of articles and utensils shaped of sheet metal. The toggle drawing press is today a familiar tool in thousands of factories, and the present-day machines are very little different in design from the first machine made by Frank Leavitt.

He has designed scores of other machines, from the simplest to the most complicated of automatic machines which work so ingeniously that they seem almost to be endowed with a brain. He is one of the most prolific inventors alive, and the fact that his name is not a household word bespeaks the modesty of the man.

"Why," said one of his associates through the past 20 years, "I have seen Frank Leavitt for weeks at a time keep as many as 25 draughtsmen busy, each on a separate job, and he was furnishing the ideas for all of them. Frank Leavitt, in my estimation, is the greatest mechanical genius that ever lived."

Perhaps that is extravagant praise, but there is no doubt that Mr. Leavitt possesses mechanical ability of a most unusual order. He is a graduate of Stevens Institute of Technology, and with the degrees of M. E. and E. E. tacked to his name he got a job as draughtsman in the department of engineering of E. W. Bliss & Co. of Brooklyn, N. Y. His native ability soon asserted itself; he rose rapidly and while still in his twenties became chief engineer for the concern. It was in that capacity that he did most of his important work.

He apparently has considerable business ability along with his mechanical genius, for he has done what many inventors fail in; he has amassed a fortune from his inventions. He is retired now and we found him, a tall, straight figure, with iron gray hair, on his country estate at Smithtown, Long Island, some 50 miles from New York City.

Mr. Leavitt's retirement is not quite complete. He is still directing experiments, the nature of which we are not at liberty to reveal, but which may be of very great importance in the not distant future. But he has dropped most of his multitudinous activities for what he terms play.

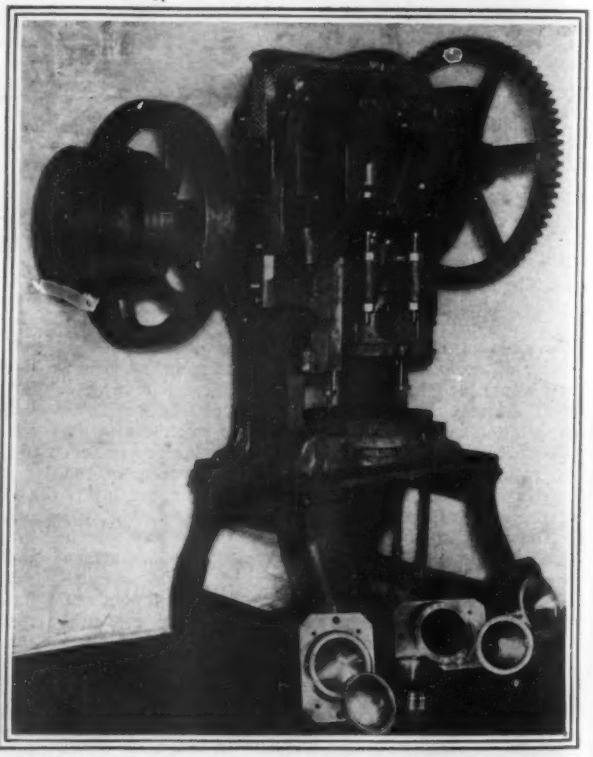
"I had a letter the other day," he said, "from a man who believes he has an improvement on the torpedo. I wrote back that I was no longer interested in torpedoes, but that if he could tell me some way to get rid of rose bugs I would be very glad to see him."

Mr. Leavitt said he was afraid anything he could say would have little value because he was so out of touch with the present industrial situation. But he admitted that he had had time of late to think of the problem created by the introduction of the automatic machine, to which he himself had so largely contributed. We regard what he did say as well worthy of record, for it is the kind of sound sense that dispels the alarm with which we are so likely to regard new things.

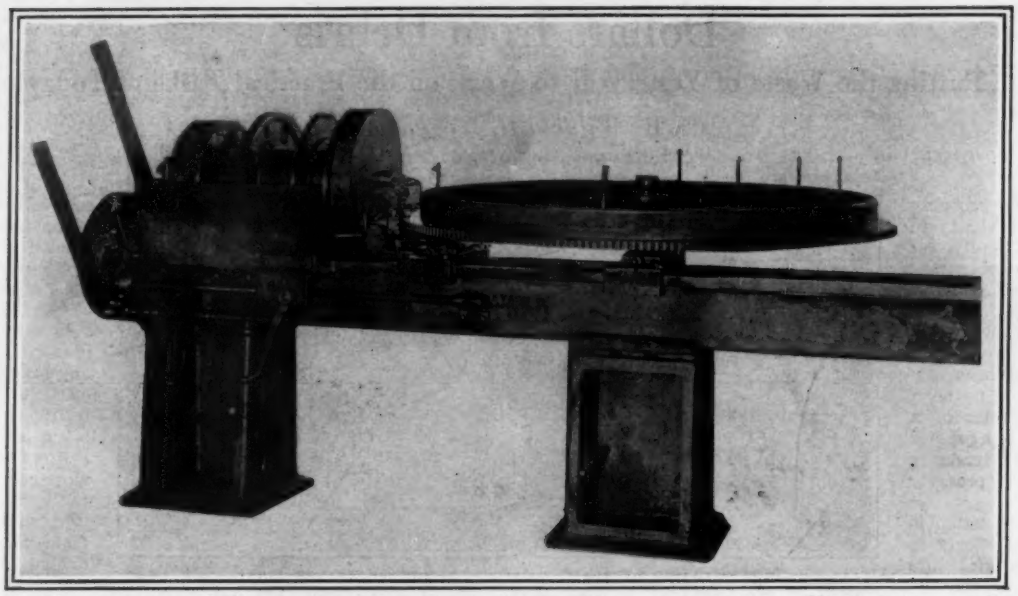
And is the automatic machine crowding out the skilled mechanic and making of him something of a human machine?

"It cannot be denied," says Mr. Leavitt, "that the modern industrial tendency is more and more toward the use of automatic machines. And further it cannot be denied that the man who operates an automatic machine has not a very interesting job. He simply goes through a set of motions that are repeated from morning to night. The machine sets the pace, and he has simply to keep up.

"Now then, if an automatic machine or any other kind of an invention destroys the happiness of more people than it helps, it is a distinct menace. And I'll have to admit also that automatic machines were not built for the purpose of making people happy—they were built to make more money for their owners. Altruism never entered into the calculations for a single machine that I ever made. I did it for the monetary reward my company would get.



The first toggle drawing-press. This machine, invented by Mr. Leavitt, is one of the familiar tools of modern industry, and has made possible cheap tinware and all sorts of articles drawn from sheet metal. Its present-day successor does not differ greatly in design and construction from the original



Machine for automatically shaping the turbine-buckets used on a steam turbine. This is not a complicated affair, as compared with the average automatic machine, but is said to be one of the most ingenious ever invented

"But what are the facts? Suppose we take the case of a worker on an automatic tin-can machine, and compare it with the case of the skillful hand worker he has replaced. The hand worker used to toil 12 hours a day to make a few score cans. The machine worker toils eight hours a day to make several thousand cans. His productivity has been increased so that he doesn't have to work so long. His wages are higher, but so is the cost of living. We'll consider that the wages are equal, for the sake of argument.

"More than likely the modern machine worker owns a cheap automobile. At least he hopes to own one, for an automobile nowadays is within the reach of the average man. What made it so? Automatic machinery! As a matter of everyday equipment the modern worker has in his home scores of things which were luxuries to the old-time hand worker. In a good many cases this is so because the application of automatic machinery to the manufacture of these articles has so reduced their cost that they can be had on an ordinary income. The market value of any article is governed almost entirely by the amount of labor that goes into it.

"A factory can be equipped to produce almost any article of commerce by automatic machines if there is sufficient demand for that article to justify it. And the fact that the article can be made cheaply immediately stimulates the demand for it. The two circumstances go together. The development of the cheap automobile is a good example. Now there is very little demand for a car costing $5,000, but if a factory could be equipped to turn out the same kind of a car merely by pressing a series of buttons, the rest being accomplished automatically, that car could probably be sold for less than a flivver. It wouldn't be long until everybody would be riding in one. And so I think if the worker at an automatic machine who complains of his lot were given the choice of foregoing all of the pleasures and conveniences that are his because of automatic machinery, or of returning to the old days of hand labor, it would not take him long to make his choice.

"Labor has consistently opposed the introduction of automatic machinery from the very beginning. When you install a machine which does the work of ten men, it is pretty hard to convince the nine who lose their jobs that you are doing them a favor. Actually you are doing them and the whole world a favor. You are reducing nine-tenths the cost of that particular article. That means that many people who could not afford them will now be able to buy. The demand will be stimulated and it nearly always happens that more men than ever before are engaged in the manufacture of that particular article."

"Then, Mr. Leavitt," we said, "do you admit the charge that the skilled worker is being replaced by the automatic machine?"

"What I say is," he replied, "that if the skilled worker is giving way to an unskilled machine tender, the present condition is infinitely to be preferred to the 'good old days,' and I see no great danger in proceeding with the process of automatizing industry with all speed. Of course, that sets up new conditions, and sometimes our routine existence is rudely jolted out of its groove, but we have simply got to mold our lives and our institutions to fit the new order. I repeat that if the charge is true, the automatic machine still is to be preferred over skilled hand labor. But it isn't true. As a matter of fact there are more skilled hand workers employed in industry today than ever before.

"What of the men who build the automatic machines, and of the men who make the tools for them and who keep them running? That requires mechanical ability of the first order, and commands a much greater reward than the skilled worker who spent his time scraping and filing, even considering the advance in living costs. I believe that the young man of mechanical bent has a better chance to 'cash in' on his ability than ever before.

"The man who stands at an automatic machine and goes through a set of motions all day really hasn't replaced the skilled hand worker at all. The type of men which made up the skilled workmen of 25 years ago, today furnishes the toolmakers, the engineers, the designers and the foremen. There are more of them than ever, and as the number of automatic machines in service increases, the demand for such skilled labor also increases.

"The man who, 25 years ago, would have had to chop wood, or swing a pick for a living, today can find employment running an automatic machine and he can get a great deal more out of life than under the old hand system."

"And that," we said, "brings up another question: the influx of rural population to the cities. You say it is easy now for an unskilled laborer to go into the shops and make a good living, because of the automatic machine. Does that not account for the fact that a great many farm boys prefer the cities to the drudgery of the farm? Isn't that partially responsible for the fact that up and down the Atlantic seaboard there are thousands of abandoned farms; and for the general complaint among farmers that the boys will not stay on the farm? There has been a heavy increase in urban population in the past 25 years without a corresponding increase in the country population. It has been repeatedly pointed out that this situation is a distinct menace. What do you think of it?"

"It is true," said Mr. Leavitt, "that the automatic machine makes it easier for the farmer to migrate to the city, just as it is easier for any man to change his occupation than it once was. But I think we shall have to look further for a reason for the decrease in the percentage of rural population. In normal times there is bound to be an economic balance between the rural and city populations that will maintain itself without your or my worrying about it. There has been great improvement in agricultural methods at the same time there has been improvement in factory methods. The product of the farm is food, and a man can eat only so much food; but his consumption of manufactured articles is limited only by the size of his income and the buying power of his dollars. The automatic machine has increased the buying power of the dollar, and the resulting demand for the products of the city has called for more and more men. On the other hand, it takes less labor to produce a given amount of food, and the demand for farm labor has not been as pressing. Hence the influx of farmers to the cities. I think the complaint that the boys will not stay on the farms comes from the farmers who have not kept up with the procession and who have not grasped the advantages the automatic machine has brought to their doors."

"Granting all this, Mr. Leavitt," we said, "it still seems that a dangerous situation may come from the rapidly increasing use of the automatic machine. You know that when machinery was first introduced in England, it placed in the hands of unscrupulous employers a power which they misused. They used their new tools not to benefit the community and the nation, but to extract larger profits for themselves, to browbeat their men, to press children into their service and to commit all sorts of wrongs, which were a long time in being rectified. Now isn't there something of a parallel situation today? We know of a factory, which is one of a great combination, which during this recent slack period has taken out practically all of its production machinery and installed automatics throughout. When they go back into production they will hire only a part of their former force.

"Now that factory, it seems to us, can do one of three things. It can pass along the economies effected to the consumer and in that case the happy cycle which you predict will likely take place. But the kind of automatic machines they have installed were especially designed by a large engineering force and will not be used outside their own walls. Their smaller competitors have not the resources to do the same thing, and if the larger concern cuts prices, will it not have the effect of putting the smaller concerns out of business? And is it not quite possible that this great concern will choose not to reduce its prices, but to maintain them at the highest possible point to extract a larger profit? In fact, doesn't the automatic machine require large financial backing and doesn't this fact tend to larger and larger combinations of cap-

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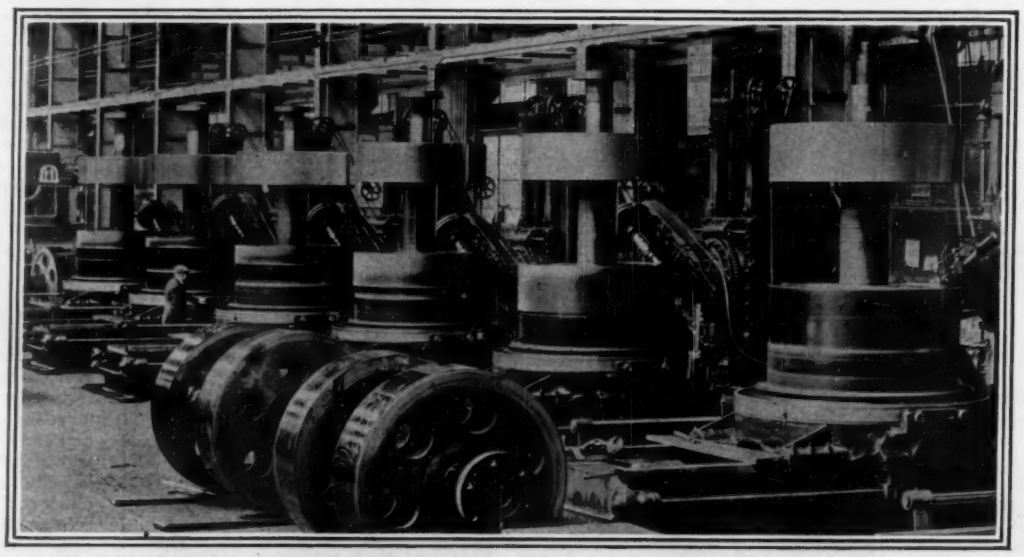


A modern development of the automatic machine. With the attention of one man, these huge contrivances cut spiral gears for steam turbines. Note the size of the blank gears in the foreground, and the small bulk of the man as compared with the machine

Dollars from Debris

Putting the Waste of Yesteryear to Work on the Practical Tasks of Today

By William H. Waggaman
Bureau of Soils, Washington, D. C.

SOME astute philosopher who probably had purchased the patent rights to perpetual motion sagely but sadly remarked that one of the greatest curses inherent to mankind is the desire to obtain something for nothing. The stricken gambler of the stock exchange, the shabby "tout" at the race track, the investor in oilless oil stock, and the suicide who borrowed the bank's funds to clean up on a "sure thing" are typical examples of a weakness which we all possess to a greater or less degree. And yet this tendency when carefully controlled and properly directed is really one of man's greatest assets, and the advance of civilization is to a large extent due to our efforts to turn seemingly worthless material into valuable and useful products.

Transporting garbage to the rendering plant where oil, soap-stock, and fertilizer are produced at what used to be a sure profit, but has recently become a very shaky one

The United States with its great oil fields, its immense deposits of coal and metal bearing ores, its virgin forests and vast areas of rich agricultural lands has long been the envy of nearly every other nation, but we are waking up to the fact that our wealth and resources are by no means proof against exhaustion. Some of the highest grades and most accessible deposits of ore from which we obtained our copper, lead, and zinc are now little more than memories of the oldest inhabitants. Only deserted ruins mark the location of many rich gold and silver "strikes," which caused thriving towns to spring up in arid wastes. We are burrowing deeper and deeper for our coal supplies. Gigantic oil gushers are now exceptional. No longer can we afford to choose perfect timbers for our dwellings or grow the same crops year after year without liberal applications of fertilizers and careful methods of cultivation. In other words the time has come when we must think, plan, invent, and work hard if we are to continue to hold our place as the leading industrial nation of the world. Those of us who still consider ourselves members of the "younger set" recall with a kind of painful pleasure how "father" used to have load after load of anthracite coal delivered at his door or shot into the cellar at the rate of five dollars per ton; and it was *coal*. Today we almost have to mortgage the old home to obtain from an indifferent dealer a few tons of a product which contains such a high percentage of incombustible what-not that the ashman expects an additional tip for hauling away the extra cinders.

Various explanations are offered for the increase in price and decrease in the quality of hard coal. Some of them are far from convincing, but one thing is sure and certain—while the demand for coal is growing greater each year the supply is rapidly growing less. In sizing anthracite for the market large tonnages of dust or culm are produced which for years were thrown aside as practically worthless except perhaps for local use under boilers, where constant attention made its burning possible. Though this dust was recognized as perfectly good coal, its shipment was considered impractical and the consumer, being used to lump fuel, did not know how to use it. For a while only half-hearted experiments were conducted with a view to rendering this slack from our coal mines marketable, but as waste piles grew and mining costs increased real effort was put into these investigations and now methods and equipment have been devised which have cut down this former waste to a minimum.

The powdered-coal burner which sprays pulverized fuel into the fire box or furnace along with a blast of air is finding a wide industrial use. In fact this invention makes it possible to utilize the heat value of coal more fully than when it is burned in lump form. For domestic purposes, anthracite coal dust is now mixed with an oil binder and pressed into briquettes which in many respects are equal if not superior to the regular stove coal. So popular has this type of fuel become within the past few years that in 1918 we consumed nearly one half million tons. This means that we have happily ended an annual loss of at least this much fuel worth at present prices considerably over $5,000,000.

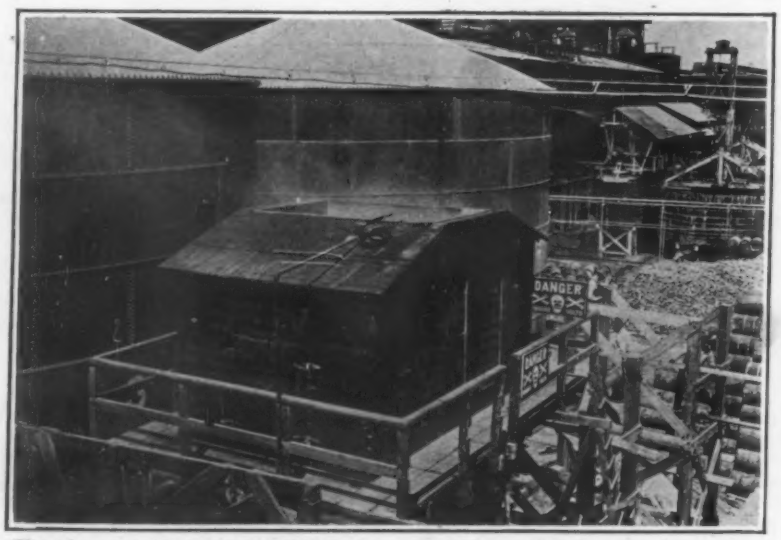
FOUR short years make a vast difference in outlook. During the war the slogan was "produce, no matter what the cost." We have been through the process of painful awakening and even more painful readjustment, and today we are applying to more and more industries the new demand "cut the cost or quit producing." One way to cut the cost is to recover values which have been allowed to go to waste under the impression that it was either impossible or inconvenient to utilize them. Junk of course we have always had with us, and have always got what we could out of it. But the sort of materials with which Mr. Waggaman deals are a little bit more subtle than junk. They are stuff that has never before attained the dignity of junk, but has been allowed rather to flow from the bung-holes of industry without a protest. What Mr. Waggaman tells us is really the story of how this material has been caught en route to the sewer and converted into junk—or, sometimes, into something even more valuable than junk.—THE EDITOR.

Not only is the briquetting process being applied to finely divided coal, but to other materials as well. Metal turnings and filings are being pressed into compact masses which can be charged into furnaces and remelted with the least possible loss. Disintegrated ores and minerals which would either blow away or clog the smelters can be nodulized and handled as satisfactorily as natural lump ore. The perfection of nodulizing processes has made available immense tonnages of finely divided iron ore formerly considered of little or no economic importance. In some cases other materials which react with or bring about the desired changes in such minerals at high temperatures are mixed and briquetted with the ore and thus more efficient and quicker results are obtained in the furnace than where the various ingredients are each used in large sizes.

Another striking instance of how an almost criminal waste may be at least partially eliminated is afforded by an investigation on the recovery of phosphoric acid from phosphate rock which is being conducted by the Department of Agriculture. Phosphate rock is the basis of the fertilizer industry in this country and though we still have enormous resources of this mineral in Florida and Tennessee the cream of our better and more accessible grades has been skimmed. In preparing phosphate rock for the market the practice has been to put it through a costly and elaborate washing and screening process to separate the rock from its impurities. During this cleansing process large quantities of phosphate are washed away along with the extraneous matter and thus irretrievably lost.

For twenty years or more we have had an annual marketed output of 2,000,000 tons of phosphate rock, and each year we have thrown fully this much on the dumps. Conservatively estimated the amount of phosphate thus lost in a score of years would be worth at present prices well over $90,000,000. The new process now under investigation gives promise of eliminating the costly washing and screening steps and the great losses which they entail. In fact the very impurities associated with the rock and which have so long been regarded as objectionable are now being utilized to affect the separation of the phosphoric acid in the most concentrated and marketable form.

And, speaking of fertilizer, here we have an institution which is one of the greatest agencies known for utilizing the wastes of other industries. It draws its supplies from the refuse of the animal, vegetable and mineral kingdoms and by nature's aid turns them back into food, clothing and housing materials for mankind. The great packing plants from which we get our meat supply are largely supported through the sale of the by-products or non-edible portions of the animals which are slaughtered. It is literally true that here everything is utilized except the pig's squeal, the lamb's bleat and the bull's malignant bellow. Hides, hoofs, horns, hair, blood, and "in'ards" are rendered into fertilizer materials which produce large yields of grain, fruit, cotton and garden truck. In recent years a number of these by-products from the packing plants have been successfully used in stock feeds, and so many a mild bovine, blissfully unaware of her cannibalistic tendencies, is chewing a cud containing various portions of her late departed relatives.



Electric precipitator for collecting dust and fumes. The danger signs serve as a reminder that the current is on, and the fumes being condensed

Cotton seed is another example of where a by-product which was once considered a nuisance is now a most valuable asset. Were it not for cotton-seed oil in its many forms the cost of the housewife's shortening, salad oil, and butter substitutes would long ago have soared to heights where war prices would sound like an old-time bargain day. Even after the oil is pressed out of the cotton seed the latter still retains much of its value, for the resultant cake is now highly prized both as a fertilizer and stock feed; every year many thousand tons are returned to the soil to grow more cotton, or fed to cattle

to enrich their milk or to enhance our meat supply.

That garbage, greatest of domestic wastes, can be made to give up its values is well known to SCIENTIFIC AMERICAN readers through several recent articles. The housewife's next most serious bugaboo is dust, though it is doubtful if the average male will ever become sufficiently civilized to appreciate the tragedy of a slight gray film on the grand piano. A decade or so back nothing short of the dust of a precious metal was considered sufficiently interesting to warrant investigation. But we have since learned that there are many other kinds of dust which can be converted into dollars.

Curiously enough, in a number of cases where dust has been turned from a menace into a boon, its collection has actually been forced upon an unwilling industry. For instance, many of our valuable metallic ores, particularly of copper and lead, contain very appreciable quantities of arsenic, and in smelting operations this arsenic is driven off with the furnace gases in the form of a fume or very fine dust. Until means were adopted to prevent it, these fumes were evolved from the huge smelters in our Western States and wafted over the farms and ranches in the surrounding country, with the result that the smelting companies not only had to pay large sums in damages but were confronted with the possibility of being closed down. They sought the best technical aid and advice, and it was not long before bag houses were installed at their plants which removed from the flue gases the bulk of the poisonous dust. Thousands of tons of white arsenic are thus annually collected from the smelters throughout the country and converted into pigments, compounds useful in medicine and in the dye industry and into insecticides for spraying gardens, orchards, and vineyards. Instead of being a menace to agriculture this arsenic is actually increasing crop yields by ridding our fruit and vegetables of dangerous parasites. Again, in 1920 over 10,000 tons of crude potash salts worth more than $175,000 were recovered from the dust given off by cement kilns in the United States.

For years conservationists have cried out against the ruthless drain on our forests and the scandalous waste of good lumber. The United States Forest Service has done everything in its power to stem the tide of timber exhaustion, not only by planting and guarding new forests for future generations but by teaching the present generation how to get more out of the material which has so long been burned or thrown away. If the lumberman, mill owner, carpenter, builder, and cabinet maker would all profit by the knowledge gained by the scientists at the Forest Products Laboratory we would be utilizing practically everything pertaining to timber except the knot holes. The waste of good lumber in those industries manufacturing such products as axe handles, wheel spokes, furniture, toys and agricultural implements has been and continues to be enormous. This is partly on account of the unnecessary care taken in selecting the wood, and partly due to the losses entailed in cutting small-dimension stock.

There is a tradition which has been handed down from father to son since before the days of Daniel Boone that the sapwood of the hickory is the only proper material from which wheel spokes and axe handles should be made. Millions of feet of hickory heartwood therefore have been thrown away because it was considered unfit for use in such industries. Exhaustive tests made at the Forest Products Laboratory, however, have proven that the prejudice against the heartwood of the hickory is entirely without foundation, and thus our available supply of this type of lumber has been very greatly enhanced.

Immense possibilities in timber conservation are also offered by what is known as built-up construction, which consists in gluing or fastening together a number of layers of small pieces of wood to make products which were formerly constructed of single pieces of timber. Not only is this built-up stock as strong as and stronger than solid wood but it enables us to utilize vast quantities of what was formerly wood waste. Shoe lasts, hat blocks, bowling pins, wheel hubs, airplane propellers and even baseball bats have been made in this way.

Amongst the unpromising industrial wastes, sawdust has long been regarded as one of the most hopeless. Immense heaps of this material mark the location of old saw mills, and it soon collects in such quantities around carpenter shops and woodworking establishments that it has to be hauled away by the truck load. But science says sawdust is full of energy, so we have decided to put it to work.

Most of us have heard the story of the economical farmer who fitted his mule with green spectacles and then fed him excelsior and sawdust in lieu of grass and ensilage. Had not the mule expired the experiment would have been a great success. Today, however, this experiment is being repeated in a modified form and with excellent results. Moreover, we do not have to go to the expense of providing the livestock with colored glasses to persuade them that the proffered food is palatable. They eat it with relish and with profit.

White-pine sawdust, for instance, when treated with dilute sulfuric acid and cooked under pressure with steam, undergoes a chemical change and is partially converted into glucose, a simple sugar which is both digestible and nutritious. The resultant mixture, which contains from 14 to 18 per cent of glucose, is then neutralized with lime, the sugar dissolved, and the solution filtered off and boiled down under reduced pressure to the consistency of molasses. This molasses is then added to the partially dried sawdust residue, and a product closely resembling bran is obtained. While considerable work must yet be done before this product is placed on the market as a standard cattle food, the experiments conducted thus far justify great expectations.

If the production of cattle food is not the aim, the processing of sawdust may be carried a step further and the sugar formed allowed to ferment so that alcohol is produced—not wood alcohol, either, but the type which once was used to rout dull care. It is estimated that 300,000,000 gallons of alcohol could be produced from the sawdust, shavings and scraps of lumber which are annually wasted at the mill. This amount compares favorably with the world's present output of alcohol from blackstrap molasses and could be increased many fold by utilizing second-growth timber and small trees unfit for any other purpose.

Alcohol has a myriad of uses besides that which the Eighteenth Amendment was designed to squelch. In many respects it is an excellent motor fuel and while theoretically less efficient than gasoline, in actual practice it gives fully as much power per gallon and is far less likely to cause the deposition of carbon in the engine's cylinders. Eventually we must have another motor fuel to enhance or replace our fast dwindling supply of gasoline, and alcohol seems to offer the greatest promise, since it can be produced from sources which are being constantly replenished.

These are only a few of the many things we are doing toward increasing industrial efficiency. While certain factory practices might be cited which spell anything but progress, nevertheless it is evident that American industry is more or less alive to the necessity of cutting down its flagrant waste. Probably no other nation has been eating up its principal at a livelier rate than we, although this principal, if carefully handled, should not only supply our needs and desires, but those of indefinite generations. We have discovered, developed and are using our wealth, and now we are rapidly learning to save it.

The accompanying table, compiled from figures furnished by the *Waste Trade Journal*, gives a graphic picture of the trend of values of old materials during the past eight years. Rubber, of course, by reason of new production processes, has become more plentiful and cheaper than it was, and this is reflected in the junk prices even more than those for new rubber. Most materials maintain a goodly portion of their war-time gain.

Left: Converting sawdust into cattle food, by cooking it for 15 minutes with dilute acid under steam pressure. *Right*: Lump fuel from coal-dust; the giant rollers for masticating the coal-dust and the oil binder before bricquetting the mixture

Some of the special machinery that has been devised for the saving of values that have always gone to waste

JUNK PRICES BEFORE, DURING AND AFTER THE WAR-TIME PEAK

For Further Discussion, See Last Paragraph of the Accompanying Text

	July, 1914	July, 1918	July, 1922	
Heavy melting steel	$11.00	$29.00	$16.75	per ton
No. 1 cast iron	11.00	32.00	19.00	per ton
Heavy scrap copper	.115	.23	.115	per pound
Heavy scrap lead	.035	.075	.045	per pound
Scrap zinc	.035	.06	.03	per pound
Old news paper	.325	.625	.65	per hundred
Old book paper	.75	1.40	1.70	per hundred
Cotton rags, roofing grade	.60	2.80	1.	per hundred
Woolen rags, mixed softs	.045	.21	.055	per pound
Woolen rags, rough cloth	.015	.09	.015	per pound
Rubber—old boots and shoes	.0625	.08	.0225	per pound
Rubber—old tires	.045	.046	.005	per pound
Grand average, in percentage figures	100.00	273.55	124.33	per unit quantity
Grand average, excluding rubber	100.00	305.46	144.48	per unit quantity

The St. Gothard Electrification

Taking the Inefficient and Smoky Steam Locomotive Out of Europe's Greatest Tunnel

By P. J. Risdon

IN one of his books Mr. H. G. Wells refers rather contemptuously to the steam locomotive as "a pumping engine on wheels." This is a very happy phrase. It seems probable that had the applications of electricity been known to Stephenson and his contemporaries, there would never have been such a thing as a steam locomotive. For the thermal efficiency of this machine is only six per cent or thereabouts, lower than that of almost any other type of engine; while the thermal efficiency of electric traction, to present but the one alternative, is twelve per cent.

St. Gothard express at Göschenen, near the northern entrance to the great tunnel

Nowhere is the handicap of the steam locomotive more keenly felt than in mountain country, where the heavy grades and the absence of straight stretches of track conspire to bring out all that is most unhappy in this method of traction. And the mountain country par excellence is of course Switzerland. The change from steam to electric propulsion is usually a slow one owing to the cost involved. To warrant the very considerable capital expenditure, it is usually necessary that there be prospect of considerable traffic increase, apart from the greater efficiency of the electric traction. In the case of the Swiss railroads, however, it is astonishing that electrification has been so long delayed. For here, once the capital to meet the cost of conversion has been provided, water power at insignificant cost is available for generating the current for working the lines.

Switzerland is today making up for her late start in the electrification field, and it will probably not be long before steam locomotives on the Alpine railroads will be relegated to the position of Stephenson's "Rocket." Indeed, it is the aim of their management to make the Swiss railroads entirely independent of coal and oil fuels, by utilizing the enormous available water-power of the country.

Among the lines on which electrification has progressed far, none is of greater interest or importance than the one that passes through the St. Gothard Tunnel. This line is of course a major connecting link between Italy on the one side and Germany and Belgium on the other, providing a through route between the capitals and many of the principal cities of those countries. Commencing in Swiss territory at Lucerne, its course is mainly southward to Chiasso on the Italian frontier—a distance of 137 miles. At Lucerne it joins the main line, via Basle, from Berlin, Hamburg and Brussels; at Chiasso it connects with the Italian roads to Milan, Rome and the rest of the peninsula. In addition to the St. Gothard Tunnel itself, 3785 feet above the sea and 9¼ miles long, it possesses a multiplicity of smaller bores—some necessary to get past minor ridges and peaks, others being introduced for the purpose of safety from avalanches. There are numerous cork-screw tunnels, and in one place two of these occur in the same mountain, one above the other.

Towards the end of 1913, and subsequently, authority was given and the necessary credits were voted for undertaking the work of electrification in three instalments; (1) the Erstfield-Bellinzona section, the longest and most costly, on which the greatest length of tunnel occurs (including the St. Gothard tunnel); (2) the Bellinzona-Chiasso section; (3) the Erstfeld-Lucerne section and the various branches The total estimated cost was about 200,000,000 francs, including 40,000,000 francs for electric locomotives. The first of these sections, about 68 miles in length, has been completed and is now in operation, and it is anticipated that the remainder will be completed in 1922.

The two principal sources of water for power purposes are the fall of the Fossbach from Lake Ritom to the river Tessin, and the fall of the Reuss River from Pfaffensprung, below Wassen, to Amsteg.

In the case of Lake Ritom, the normal capacity of the lake is 671,000,000 cubic feet, but by means of a dam at the lower end the water has been raised 23 feet higher, thus increasing the storage capacity to 918,000,000 cubic feet or 5,737,000,000 gallons. About 120 feet below water level in the lake an outlet was made, through which the water passes into a tunnel 3445 feet long and 6½ feet high. This tunnel has a fall of 7 feet in 1000, and conducts the water from the lake to the top of the high pressure pipes into which it is delivered. Ultimately there will be three of these pipes, each measuring 44 inches in diameter at the top. The pipes are laid down the mountain side to the power house 2625 feet below. Thus an effective head of water of 2580 feet is provided, giving a pressure at the water turbines of 1150 pounds to the square inch.

Since water in a pipe flows more rapidly the greater the pressure, the pressure pipes are reduced at a lower level to 36 inches in diameter. At a still lower level the pressure becomes so great that it was found more economical and safer to divide each pipe into two smaller ones. It follows then that six separate pressure pipes enter the power house at Piotta. The length of this pipe line is 4590 feet.

The average continuous flow of water from the lake is equal to 35 cubic feet a second. This delivered to the turbines under a head of 2580 feet is equivalent to about 8500 horse-power continuously, day and night, year in and year out. Unfortunately the power cannot of course be utilized in that uniform manner, and provision has to be made for the peak load which amounts at times to far more than such an average. In point of fact, six turbines (one to each pressure pipe) are installed in the power house, each of 12,000 horse-power, making 72,000 horse-power in all.

The Lake Ritom power station is at Piotta, on the left bank of the river Tessin, and contains the six power units. Each unit consists of a high-pressure water-turbine, driving a single phase electric generator at 333½ revolutions a minute. The current is generated at 15,000 volts and is then transformed to 60,000 volts. The reason for this conversion is that the higher the voltage for transmitting electrical energy over great distances the less the size of the conductor necessary—a great consideration in the matter of first cost.

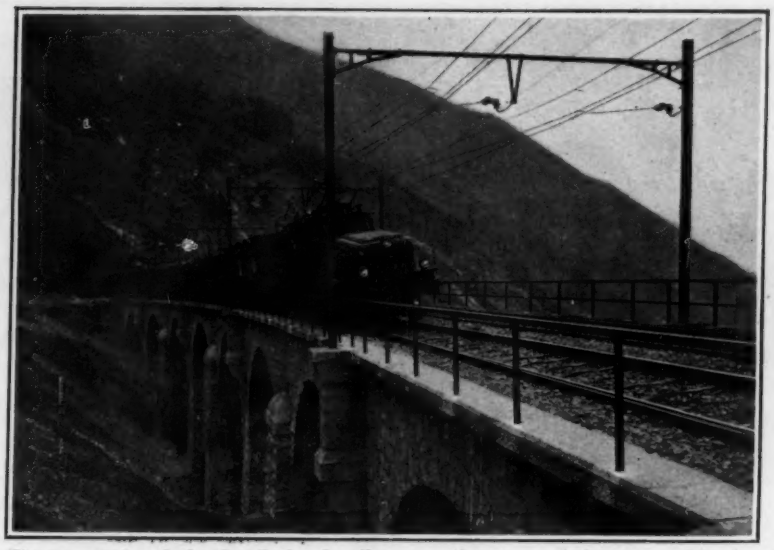
From the main power station the transformed current is transmitted to five sub-stations (Göschenen, Giornico, Giubiasco, Melide and Steinen), in some cases by overhead wires and in others by cables laid in cement troughs along the railway. At these sub-stations it is reconverted to 15,000 volts and is then delivered to the overhead wires along the railway, from which it passes to the electric locomotives and thence into the track rails.

In the case of the Amsteg power station, water is derived, not from a lake, but directly from the flow and fall of the river Reuss, so that the power available at any time depends upon the state of the river at the same time. Thus the two stations, Ritom and Amsteg, are complementary. So long as there is sufficient water available at Amsteg, water will be allowed to accumulate in the Ritom lake against the periods when the river Reuss temporarily fails in its supply: when that happens the great reserve of potential power in the Ritom lake will be drawn upon. The Amsteg power station will ultimately be equipped for the generation of 90,000 horsepower. The river Reuss will be dammed, but only sufficiently to provide against the maximum daily demand of the Amsteg power station. The dam is curved and 82 feet long. In order to prevent the collecting basin formed by the dam from becoming choked by sediment and stones brought down by the river, the latter will be diverted through a tunnel 920 feet long, at the end of which sluices will provide control of the water and enable it to be directed

View of the Reuss Valley at Wassen, with the Hindgälle in the background

either through the tunnel or into the basin.

The arrangements for directing water from the river to the Amsteg power station are similar to those for the Lake Ritom-Piotta scheme, but differ somewhat in detail. The average available water power at Amsteg during the winter period of five months is 12,000 horsepower, but to meet the peak load the turbo-generators will be of 90,000 horsepower in all. From the water intake or basin, which is made by damming the river Reuss where it passes through a narrow gorge, the water passes through a tunnel 9½ feet high, about 9 feet wide and 4½ miles long, with a slope of 1½ feet in 1000, from which it is delivered to the pressure pipes. These will be three in number and, as at Piotta, they branch into six at lower levels and feed six turbines in the power house. In this case, however, the head of water is 837 feet, giving a pressure at the power house of 372 pounds per square inch. The upper pipes are 71 inches in diameter, diminishing to 63 inches, and the length of the pipe line is 1,246 feet.



Express train of the St. Gothard railway on the stone viaduct near Giornico

The overhead wires from which the locomotives collect the current of course are of copper. Any section of either track between stations can be disconnected for repairs, leaving the rest of that track and the whole of the other track open for traffic.

The locomotives weigh as much as 128 tons each. The express engines are capable of hauling trains of 425 tons weight the whole distance of 137 miles, making three journeys in 24 hours. Where the gradients exceed 1 in 50 two engines are employed, but a single locomotive is capable of hauling a train of 300 tons at a speed of 30 miles an hour up such an incline. A freight locomotive can haul a load of 860 tons from Arth Coldau to Chiasso twice in 28 hours, taking gradients of 1 in 100, but for steeper gradients two engines are necessary. The express engines are rated at 2200 horsepower, the freight engines at 2000 horsepower.

Ample provision is made in the matter of workshops for the repair and maintenance of rolling stock, cranes of 80 tons lifting capacity forming part of the equipment.

A British Device for Locking Open Water-Tight Doors

A DEVICE has been patented in Britain for holding open water-tight doors on ships. As is well known, the movement of the ship and engine vibration tend to make the doors creep from their position and so to close, partially or entirely, the doorway. This new arrangement is based on the operation of a friction brake which is designed to actuate when the door is opened fully.

This brake is located on the shaft which leads direct to the gearing for working the water-tight door. It can be placed in any position on this shaft, either at the door itself or on the deck above the door.

The device consists, first, of a double cone, slotted and split, one end being flanged for bolting down to a bracket. If it should be necessary to dismantle the double cone it can be done by drawing the cone up through the bracket, without necessitating the bracket's being detached from the bulkhead.

The brake consists essentially of two nuts, tapered inside at one end to fit exactly each end of the double cone, and screwed at the other end to work on screwed sleeves, which are fixed to the rod. One of these nuts is a right-hand screw and the other a left, and they are arranged so that they approach each other when the door is being opened.

Nut pointers pass through the slot in the guide plates. These nut pointers are fixed to the nuts after the "open position" of the door has been determined. The internal cones engage with the double-ended cone located conically with the door shaft, the latter cone being fixed in such a position that the nuts will jamb on the cone the instant the door is open. To ensure that the double-cone grips the rod tightly when the door is open to the stops, the sleeves are fixed to the rod and the nuts tightened hard on the cones by means of a toggle. This done, the nut pointers are fixed to the nuts with the pointers projecting through the slot in guide plates.

The double-ended cone is fixed to a bracket through which the shaft passes so that as soon as the nuts and cone are in contact, the friction between these components prevent the shaft being rotated.

The angle of the cone is so arranged that no vibration will release the brake, but, at the same time, a turn of the shaft to release the door to close it will lift off the braking action entirely. The split cones grip the rod and prevent any movement of the door when the ship rolls.

A simple indicator which can show in any convenient position whether the door is open or closed is arranged to work on the two nuts.

This device can be applied to any shaft where a locked position is required at any point, such as skylight gear or sluice-valve.

Amsteg and Bristenstock, whence comes the water supply of the power station

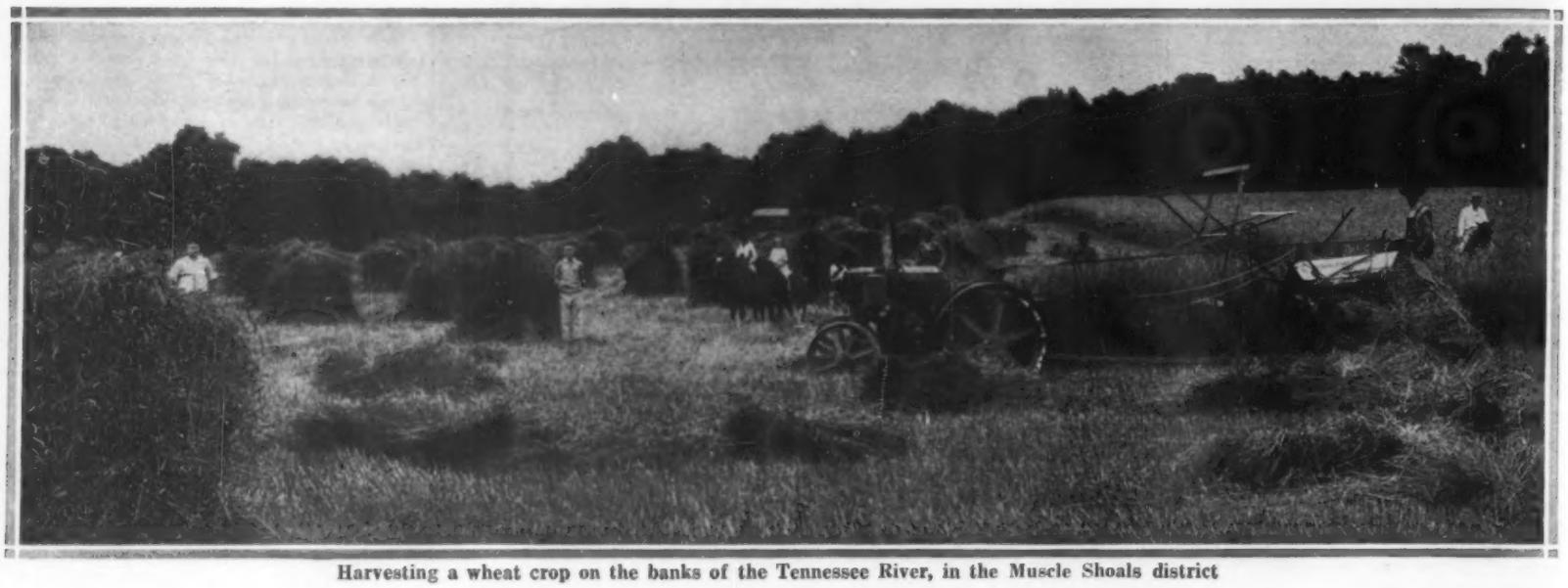
Superheated Steam Causes Failure of Cast Iron

PROFESSOR CARPENTER'S well-known experiments on the growth of cast iron under the influence of high temperatures have thrown much light on this subject. Curious failures of cast iron parts subjected to superheated steam do occur occasionally, but by renewing these parts with special cast iron further failures are generally obviated. This experience coincides with Professor Carpenter's conclusions, that there is a great difference among different qualities of cast irons as regards their heat-resisting properties. Doubtless turbine and engine builders have at some cost to themselves discovered which cast irons give least trouble when brought into contact with superheated steam, but the makers of cast iron steam pipes have apparently no rules to guide them, with the result that failures among cast iron steam pipes, elbows and valves, if used for superheated steam, are of increasing frequency. When a pipe is used for conveying superheated steam its diameter apparently grows larger and larger, though the temperature may be considerably below that at which Professor Carpenter noticed any creeping. But the circumstances are not the same. In his case the metal was not in tension, nor in contact with steam. In his case, as well, the swelling of the cast iron was traced to the gradual oxidation of the silicon in the cast iron due to the penetration of oxygen into the metal. Steam pipes are, of course, not exposed to the action of atmospheric oxygen, except to a limited extent on their outsides; but it is well known that superheated steam will attack iron, as in the Barff process, and there are indications that even saturated steam produces changes in cast iron steam pipes. In fact, some chemists claim that they have proved that iron is soluble in water, the contact waters depositing red rust if exposed to air.

An interesting example of a failure of a steam pipe, which was said to be steel, but was evidently some special cast iron, is given by W. C. E. Stromeyer, Chief Engineer to the Manchester Steam Users' Association. This casting was only two years old, but the numerous gaping cracks leave no doubt that the metal had completely lost its character. The inside of the pipe was coated with red rust, indicating chemical action. The two cracks which extend to the outside of the flange are much wider at the outside than near the pipe. This indicates that the pipe had swelled considerably, while the outside of the flange had not followed suit. A circumferential crack does not extend at all into the fracture. The superheater was installed in 1901, and there have been many previous failures of cast iron pipes in this range of steam pipes, including some of the renewed parts like the above. This suggests that change of material will not always counteract the effect of superheated steam.

China and the Automobile

THE eventual market for motor cars in China is difficult to estimate. With an adequate mileage of good roads, possibly 500,000 Chinese officials, bankers and merchants could be considered as prospects. Generally speaking, other native classes cannot afford to purchase cars. Among the foreigners in China, the Europeans usually prefer machines made in their own countries. This leaves the American, Russian and Japanese colonies; as a rough estimate they might be said to include possibly 10,000 future purchasers.



Harvesting a wheat crop on the banks of the Tennessee River, in the Muscle Shoals district

The Seventy-Five Mile City

What Henry Ford Wants to Do with Muscle Shoals, and Why He Wants to Do It

By Littell McClung

BEFORE the advent of machinery it was not possible to make, or to use, large quantities of anything in any one place; or even to bring large quantities of anything to one place. This was the dominant circumstance in the medieval civilization. Each locality was self-contained and self-sufficient. And since the smith could not be kept busy and could not be afforded a living by doing blacksmithing for his neighbors, he filled in his time and his needs by doing a wide variety of other things for himself. In particular, he was largely the producer of his own food.

Late in the eighteenth century there was a period of discovery and invention, in which modern machinery had its genesis and in which power was for the first time usefully applied to machinery. Immediately it became possible to consume in a single shop far more raw materials than could be produced in the entire neighborhood, and to manufacture in the one plant far more of the finished article than could be used in the neighborhood. Transportation thus became a necessity; and the same agency—steam power—which had made it so made it also a possibility. At once there began the development of the "factory system," under which a large number of people work with machines and material provided by an employer; give their whole time to this work, in a building provided by their employer and removed from their homes; and in return receive money wages which they exchange at the store for whatever they require of the products of other workers similarly circumstanced. Farming is less suited to this organization than any other industry and has been slowest to adopt it; but even here, a modified factory system largely prevails. And in the marketing of his wares the farmer has, of course, had to fall in with the economic system of which his ultimate consumers are a part.

This way of doing things has vastly enriched the world; its benefits are greatly in excess of its demerits and we could not possibly think of scrapping it as a whole. At the same time it has many drawbacks and is peculiarly liable to abuses; and much thought has been given by individuals to the possibility of modifying it in detail so as to avoid some of these. Henry Ford's Muscle Shoals project is the latest and one of the most ambitious of these attempts to retain the good and reject the evil of the factory system; and failure to visualize it as such, or to give it its place in the setting of the world's industrial development, involves a failure properly to appraise it.

Ever since the present industrial system began to gain headway, it has leaned more and more toward the segregation of the working population into four groups. First we have an army of men engaged in tilling the soil and producing the animal and vegetable crops that feed the nation and keep its mills supplied with textile raw materials. Second we have the army of miners who produce the mineral raw substances which are equally essential to manufacture. Third, we have the army of workers engaged in the factories themselves, producing automobiles, clothing, wash-boards, egg-beaters, jewelry, tools, wonderful automatic machines for the better functioning of the factory, the farm and the mine—all the countless items in the list of the factory-made apparatus of modern civilization. And fourth we have the army of transportation workers, who carry the raw materials from the place of production to the place of fabrication, and move the finished products from the place of fabrication to the place of use.

THE most unfortunate feature of Henry Ford's plan for the utilization of the Muscle Shoals property is that he has chosen to couple it with what most of us believe to be an unsound scheme tending toward the debasement of our currency. The fact is, however, that the "75-mile city" is a complete and independent idea in itself, in no sense part of Mr. Ford's questionable financial views. While not necessarily attainable, it is by no means the wild dream which it is so often represented to be. A fair presentation of what Mr. Ford aims to do deserves to be made; and such a presentation demands that the idea be given its rightful setting in the economic history of modern times and in the economic structure of today. This we believe Mr. McClung has done very well indeed. It remains only for us to say that Mr. Ford is not personally responsible for the present article, and neither is the Editor; it represents Mr. McClung's interpretation of the Ford idea.—THE EDITOR.

Mineral products and transportation are bought by the individual in negligible quantities, especially under a scheme that substitutes hydroelectric energy for that of coal in cooking and heating, as Mr. Ford's does. But all of us must have food; and all of us must have a large number of factory-made articles of one sort or another. Mr. Ford therefore puts forth a suggestion that amounts to this: We can afford to let the miner and the railroad man retire within the shell of their narrow interests, if they insist upon so doing; but we cannot afford to have the farmer and the industrial worker do the same. So he advances a scheme for the promotion of direct and permanent cooperation between farming and industrial activities, and the broadening of the horizon and the improvement of the material fortunes of those involved. Always before the factory has robbed the farm of its best man-power. Through his "75-mile city" Mr. Ford would have the factory and the farm working hand-in-glove.

The average factory worker today must live in the city. He may save enough from his wages to buy a home, but this will not be located in the best neighborhood, and will be peculiarly liable to loss in value through deterioration of its surroundings. Even if it is desirably situated, there is little besides the house; ground ownership to any extent is impossible. The more worthwhile the home, the more remote it must be from the factory and the more time consumed in tiresome journeys to and from work. Food, fuel and clothing absorb the pay of the average city worker, even that of the skilled men on good salary; the cost of distribution in a great city is a controlling factor from which there seems no escape. Mr. Ford, the world's largest employer of men, realizes better than most the continual struggle to make ends meet that is involved in the effort to maintain a decent standard of living and give the desired advantages to a family of children. He wants to give the workers opportunity to labor advantageously in a rural or a semi-rural environment, making the home largely maintain itself while surplus money is earned in the factory.

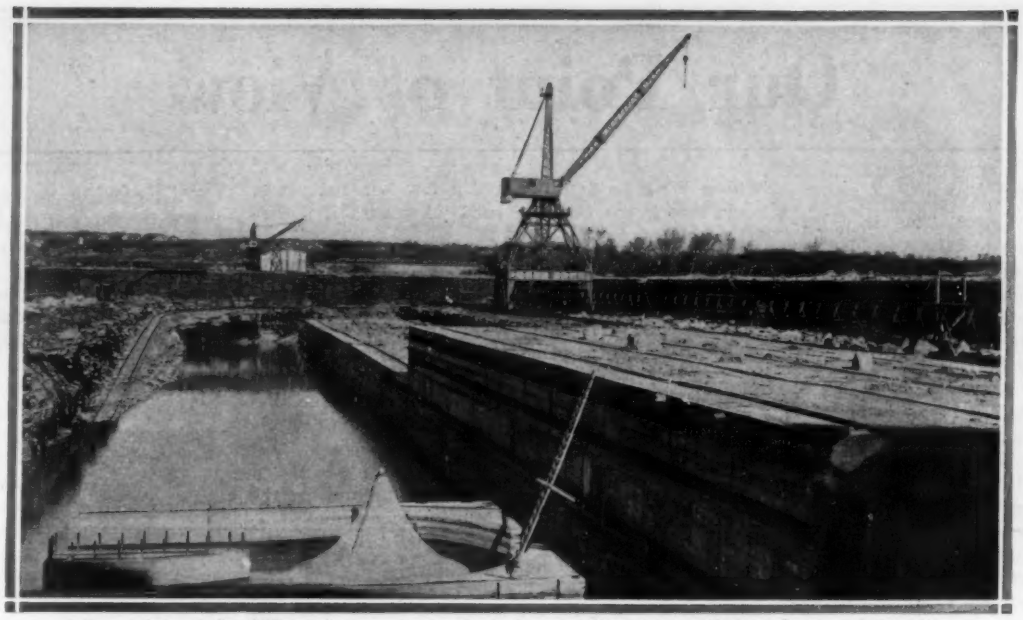
The first step toward realization of this idea would lie in the establishment of a new industrial center. The factories and the homes in any existing industrial district are fixed, as regards both character and location. Then, too, the Ford scheme calls for land, and land in great quantities; and this would be available at a practicable figure only in a new community. The industries of this new center would be related, in the sense that they would have a common source of hydroelectric power—a source of great magnitude, necessarily. They would all be related to one another, in the sense that so far as possible they would use one another's products and supply the goods consumed by their own workers, both in the home and in the field. They would not be concentrated within a smallest possible area as is the usual practice when industries, related or unrelated, are grouped in one city or one part of a city. They would preferably straggle out along the banks of the stream or streams from which they were deriving their power. There would be plenty of room between and around them.

Between these correlated hydro-driven plants would extend the farm-homes of the factory workers. An employe can have a five-acre patch for home and garden; a ten-acre plot for cow, hogs and a small field crop; or even a small farm of forty or eighty acres—and be a food producer and a salary-earner at the same time. Mr. Ford's eight-hour day and five-day week make this practicable. Yet these are not enough. The more important factor of success is present already in the Ford organization. Each man learns thoroughly several jobs in the factory; for each job there are

three or four times as many capable incumbents as are needed at any one time. When any worker is absent from his job, another who knows his work just as well steps to his post and takes his place till he returns. This makes leave of absence a simple proposition, where in the average factory it would be beset with extreme complications. Perhaps a concrete illustration will show better than any amount of abstract explanation just how the thing works out, in Mr. Ford's mind.

Bill Jones, a reliable machine worker with a family, has bought for $50 an acre and on reasonable time a forty-acre place two miles up the lake or out in the country from where he works. It is time for sowing wheat. Bill is given two weeks' leave—more if needed; and another man, trained in his work, takes over his machines for this time. Bill goes a-planting; but he is not left to work out his own salvation in blissful ignorance of how to run a miniature farm. An experienced farm demonstrator is on hand to aid him. Tractor, plows, pulverizer, harrow, grain drill are rented from the factory management—it has many of these, but not so many, and hence not so heavy an investment, as a group of independent farmers of size comparable to the group consisting of Bill and his fellows; for not all of these men will be using the harrow at the same time. The land is plowed; then disked and rolled at one operation—giving a compact seed-bed. Then it is drilled and seeded. Two weeks of Bill's time—or at most three, depending upon the state of the weather—here, and a few odd days later on, are all of Bill's time that is invested in the crop. With the exception of the tractor, no implement has been used for more than four or five days, and all of them are easily switched to other farms in the neighborhood. When planting is out of season the tractor goes into hauling ties, logs or timber; clearing waste land; sawing; or transporting material. After the community really gets started there will be much off-season work in road-making.

The following year—about when spring is warming up into summer—Bill's small wheat crop is ready to cut. He rents a binder and again a tractor from the factory. With the farming instructor at his elbow, Bill's grain is quickly cut and in the shock. Then a community thresher comes along and it is threshed. The grain is carried by barge or with tractor to the community elevator. Here it is honestly graded and Bill receives a check for his product, less the rental charged for the farm implements. Later the wheat is ground in the electrically-operated mill. In addition, Bill has straw to sell while also keeping enough for bedding for his cow.



A portion of the Wilson dam as it stands today, needing 18 months' work to complete it

The result of these systematic and intelligently directed operations is that Bill Jones has made a crop surprisingly cheaply, and has made an excellent profit on it. He did not have to buy horses or mules and feed them through the year. He has had no money tied up in machinery, although he has had the use of the most effective farming implements. And the farm demonstrator, without cost to him, has prevented him from making foolish or costly mistakes. Incidentally the outdoor work hasn't injured his health or detracted from his appetite.

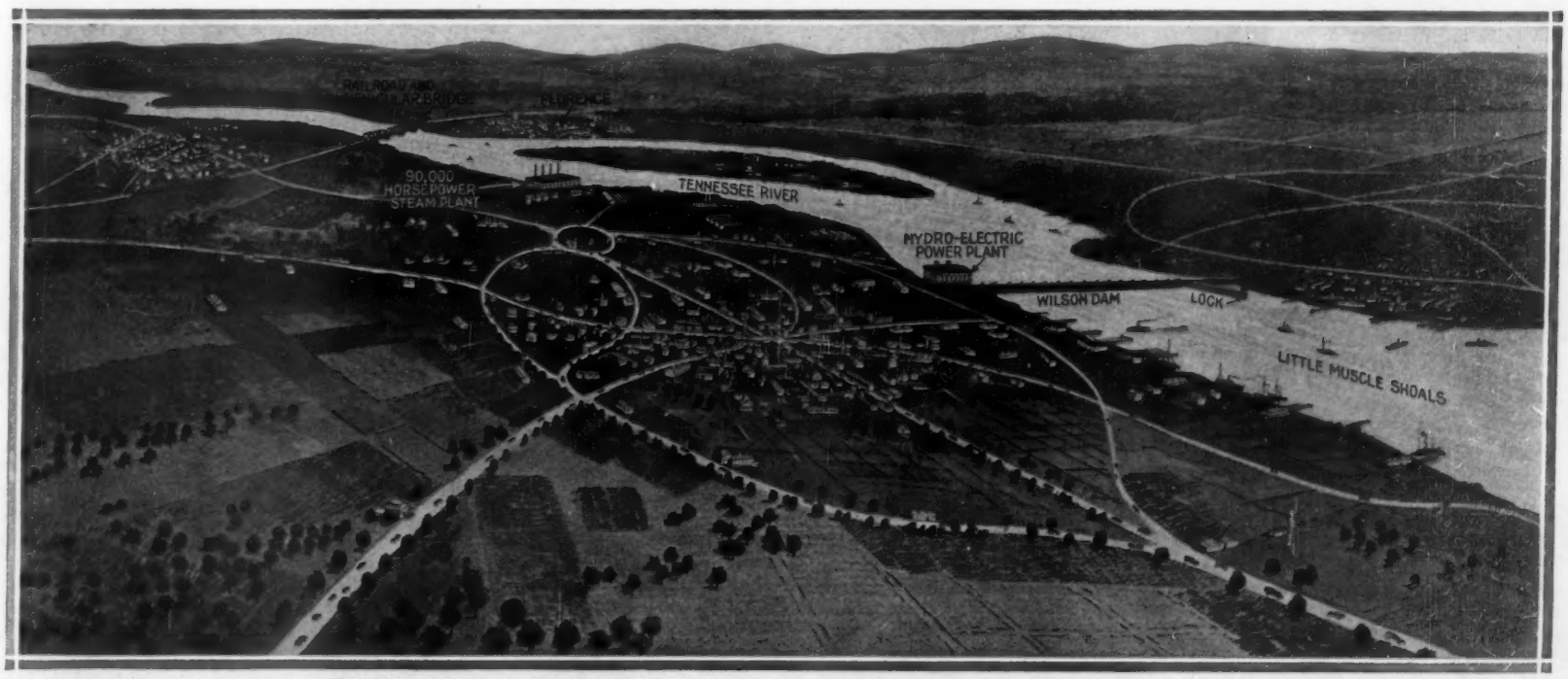
Bill's wheat acres will not lie fallow during summer. In March the crop-directing expert had Bill and the boys sow lespedeza in the wheat. Now, with the grain cut, the lespedeza is already blanketing the stubble field in green—fine pasture and soil renovator. Meanwhile the farming adviser has helped Bill plant more blackberry vines along the hedges and set out some pear, peach and apple trees. When these come into bearing a woman home demonstrator will show Mrs. Bill Jones how to can and preserve the fruits for winter use.

Bill's eight-hour day and five-day week give him adequate time to spade, plant and keep his plot free from weeds and keep down insect attacks. Meanwhile the wife is raising a few chickens and there are plenty of eggs for home use. In time there is a surplus to sell. Bill goes to work each morning in his motor-boat from his own little pier, or in his own flivver, as the case may be. And so he can take eggs and surplus garden produce with him to the factory market.

In time Bill and the family discover that they are living at little cost. They do not have to buy any milk, cream, butter, eggs or vegetables. These were continued purse-draining items where they formerly lived and worked. Nor do they have to buy coal or wood. The power lines run into the home—electricity for lighting, heating and cooking; current for churning, sweeping, washing and ironing—and very cheap. Bill is making and saving money right along to an extent quite impossible with workers in large cities and even in small ones. In time he is enabled to finish paying for his home and land. When he gets to the age where he figures that he has had all the factory work that he needs, he buys a larger place or adds to his acreage and gives all his time to stock and crops. Incidentally he has a pension and a couple of boys in the works; so that his family is about four times as prosperous and six times as contented as it would have been in the ordinary run under the old industrial dispensation.

So much for the bare bones of the idea—an idea which had been formulating itself in Mr. Ford's mind for some time. In fact, he would probably be at a loss to state just when it was first incubated. We have preserved a strictly non-committal attitude with regard to the kind of factory that Bill Jones works in, and other details of the project; for until the precise location is settled these cannot be crystallized. It makes a difference whether the mineral wealth of the region runs largely to iron, or to copper, or to aluminum, or to oil, or to coal, or to sulfur, or to something else; just where the project is located on the existing industrial map of the United States; what kind of agricultural soil is present; what kind of power may be developed and how much thereof. It is not by accident that they make automobiles in Detroit.

(*Continued on page 213*)



A birdseye view of the Tennessee Valley in the Muscle Shoals neighborhood, showing the Wilson Dam, the existing cities of Florence and Sheffield, etc.; and suggesting how these features would become part of the general scheme involving the whole valley

Our Point of View

Radio—A Necessity, Not a Fad

HAS radio played itself out? That is a perfectly natural question to ask. Consider the cold facts in the case: several months ago, radio occupied the very forefront of public interest. Manufacturers of radio equipment were simply swamped with business. Stores received some of their goods in the morning, only to have them cleared out by noon. Magazines on radio sprang up from day to day, until some thirty periodicals devoted to this new art can now be turned to for radio information. Books came out at an alarming rate. Everybody talked radio, wrote about radio, played with radio, laughed with radio, danced with radio, invested in radio—at least that was the impression gained at that time.

Several short months have gone by. Today, radio is in the background of public interest. Instead of radio, the thoughts of young and old alike turn to outdoors—walking, riding, motoring, canoeing, boating, traveling, camping, hunting, fishing, and so on. Only an hour ago the writer of these lines chanced to visit the radio department of one of New York's leading department stores. Five months ago this department was a beehive of activity. About a dozen clerks lined the counters; the customers, on the other hand, stood in solid lines two or three deep. The customers literally begged for radio goods, and the clerks were compelled to make all kinds of promises for delivery in one month to six months. The problem was not one of selling; it was one of production. Today, however, the tables are reversed. The writer found but one clerk at the counter, and two young men examining a loud-speaker, more out of curiosity, no doubt, than from a buying turn of mind.

Everywhere it is the same, at least here in the East. From the Middle West and West, no such slump is reported. But let it be remembered that radio had its first boom here in the East, and it is only now that the other sections of the country are reaching the peak of radio interest.

Many factors have caused the present radio slump. Most important of all, no doubt, is the fact that summer is here. At this time of the year everybody turns to the great outdoors. Radio is primarily an indoor sport, even though portable sets are available. Then again, radio and summer weather do not get along quite so well; the static, or atmospheric disturbances, are persistent and powerful at this time and radio music and talks are therefore broken up and muddled until they are sometimes hardly worth listening to. In great measure the phonograph has swept right back to its customary popularity, mainly because the weather has no effect on it.

Yet all these conditions are but passing ones. Radio has a real mission to perform and even in the present state of the art, it fulfills its purpose fairly well. The fall and the winter to come will witness a big revival in radio interest. As soon as the weather cools down and indoors again looks good to us, radio will occupy our evenings. We shall again listen to concerts and talks, weather reports and bedtime stories for the children, and so on, diverting our usual phonograph-record money to vacuum tubes, "B" batteries, and other features of the radio receiving set. Radio is a necessity during cold weather—indoor weather. The "fad" stage of radio has no doubt gone by. We are down to rock bottom in a very substantial art which must find a permanent place in our everyday life.

At Last the Helicopter

IT is a source of satisfaction and in agreement with the fitness of things that the first successful helicopter should have been produced in the same country that witnessed the birth of the successful flying machine. It is true that the flights of the Berliner helicopter, as described elsewhere in this issue, were very modest, both as to the vertical height attained and the horizontal distance covered; but modest also was Wilbur Wright's first flight of a few hundred yards, made among the Carolina sand-dunes with a power-driven biplane.

As we look at it, the indispensable requirements in a successful helicopter are, first that it shall be able to lift itself to any desired height and return to earth with the same safety and freedom from breakage which characterizes the airplane; second, that having raised itself to the altitude determined upon by the pilot, the machine must be capable of horizontal flight under complete control as to direction by the pilot; third, its motive power must be absolutely dependable, so that if it consists of a single motor it must be guaranteed to run without any possibility of failure during the whole of a proposed flight, or it must consist of a multiplicity of motors so disposed that the failure of any one will not mean a headlong fall of the machine to earth.

The Berliner machine, judging from the reports which have reached us from the flying field where tests are being carried on, is capable of lifting itself to a certain altitude, and then by tilting itself in a horizontal plane by means of an ingeniously disposed propeller near the tail, it can move forward at a very moderate speed, its movements being under the control of the pilot. Now, it is this combination of lift and progression that entitles young Berliner to the credit of having produced the first successful helicopter. Several earlier experimentalists have built helicopters that could lift themselves from the ground, but so far as our records show, none of them succeeded in passing from a vertical to a horizontal movement. The theory of the thing was well understood, and more than once it was suggested that a universal joint between the engine and the propellers would enable this difficult feat to be performed. Berliner has showed originality in using a small vertical propeller placed toward the rear of the machine and driven by shafting from his main engine.

A survey of experimental work in aeronautics would probably show that more attention is being paid to the development of the helicopter than to any other branch of heavier-than-air aeronautics. Thus there is the attractive prize of $250,000 which has been offered in Great Britain for a perfected helicopter, for which competition Mr. Louis Brennan has built a machine in which are embodied the results of extensive and very costly experimental work.

The Germans are credited with having built a machine which has risen with observers, and descended without mishap, but it has never attempted horizontal flight. Dr. Zahm says "there are two types of planes that are designed to fly vertically, one of these being practically of the normal airplane type with wings, with the difference that it is provided with air vanes set at an angle, on which the wash of the air-stream produces a component of upward lift sufficient to cause the machine to rise. When the desired altitude is reached the vents are adjusted so as to secure horizontal movement." Another type, according to Dr. Zahm, was also built along generally normal lines, and carried three propellers, one at each end of the wings, and one in the center. For lifting, the wash of the central propeller acted upon elevators on the tail of the body, and the wash of the side propellers against special ailerons on the wings. According to the Associated Press, Dr. Zahm is credited with stating that both planes are entirely feasible, and can be constructed at any time.

It is certain that so long as we are tied to our present materials and types of motors, the helicopter will find its usefulness only in a very limited field of operation, for it is inherently debarred from the speeds which are attainable with the normal airplane. At present it would seem to have, even if perfected, little value outside of military operations. Here, as a substitute for the observation balloon, it would be a valuable acquisition. In conclusion, it may safely be said that the greatest problem confronting the designer is to find the best means of landing the helicopter without a disastrous all-round smash-up.

Growing Safety of Railway Travel

THIRTY-FOUR years ago statistics of railway accidents began to be carefully recorded, and in the intervening years, and especially of late years, the Interstate Commerce Commission has kept a very close watch upon these accident statistics, and has given them to the public at regularly recurring intervals.

The Commission has recently published the statistics of accidents for 1921, and although they are not complete, they are sufficiently so to justify the assertion that, for the year 1921, our railways were operated with a degree of safety that was never reached in all the preceding 34-year period. The year 1920 was itself remarkable, inasmuch as the number of persons killed in proportion to the number employed by the railroads and the amount of traffic handled, was the smallest on record. These statistics for 1921, however, are even better than those for the preceding year. To begin with, as compared with 1920, there was a reduction of 48 per cent in the number of employes on duty killed in train or train-service accidents; moreover, this is the smallest number of employes on duty killed in any year of American railroading for which we have statistics There was a reduction of 10½ per cent in the number of passengers killed, as compared with 1920, and this is the smallest number in any year except 1895, 1896, and 1915. Lastly, the fatalities to "non-trespassers"—employes, passengers, and other persons having a right to be on railroad property—were reduced 28 per cent, as compared with 1920.

The only class of persons in which fatal accidents showed an increase was "trespassers," 2,166 of these having been killed in 1920, and 2,481 in 1921, an increase of 14½ per cent. These fatalities, however, were entirely due to the foolhardiness of the victims, and were in no way chargeable to the railroads. The most striking comparison, as showing improvement in the track, rolling stock, and signal systems of the United States railroads, is that between the year 1921 and the year 1907, which was the dark year for railroad fatalities, when the total of people of all classes killed reached the appalling figure of 11,839, of whom 4,534 were employes, and 610 were passengers. Since that date there has been a fluctuating but a general decline in the number of deaths until we reached the highly creditable record for 1921. Although in this year the railroads handled over 30 per cent more passengers, and about 50 per cent more freight than they did in 1907, the number of employes and passengers killed was 66 per cent less than in 1907, and it is believed, by the Commission, to be less than the number killed in any year since 1899.

Now the full significance of these figures will be understood when it is stated that, as compared with 1889, the statistics for 1921 show that the number of employes has increased some 140 per cent, passenger traffic some 225 per cent, and the amount of freight handled about 400 per cent. The moral of all this is that the "Safety-First" movement, which is showing such good results all over the country, has made itself felt strongly in railroad operation. Much of the credit, of course, should be given to the many improvements in track, rolling stock, and signalling; but it is well understood among railroad officials, and indeed among the men themselves, that the most fruitful source of accidents is carelessness and disobedience. We are justified in believing that it is to the increased vigilance, fidelity, and discipline of the personnel, that the main credit for the present gratifying conditions should be given.

Josephus Daniels Writes a Book

THE Honorable Josephus Daniels, former Secretary of the Navy, has written a book which he calls "The Navy at War." Like every public utterance of Mr. Daniels during his term of office, this book, either by direct statement or by strong implication,

Our Point of View

is filled with unlimited praise, both of his administration of the navy and of the military operations in which it was engaged after we entered the war. So far as he praises the war achievements of our officers and men, we are entirely in agreement with him; but so far as he eulogizes the work of his department in Washington in the period preceding and immediately following our declaration of war, we feel constrained to warn our readers that the book is a gross misrepresentation of the facts. In saying this we speak by the book and by the record. Let anyone who may chance to buy Mr. Daniels' book compare its eulogies of himself and his administration, and of the condition of the navy when the war burst upon us, with the official record of the hearing before the Senate Naval Committee, which was called to inquire into charges of dilatory and incompetent administration during the first few months of the war. A more damning indictment than this hearing of the Secretary's failure to make any effort to get the navy ready for the great emergency it would be impossible to conceive.

In spite of the repeated warnings of Admiral Fiske, whose duty, as Chief of Operations, it was to keep the civilian Secretary informed about the condition of the navy; in spite of the Admiral's statement that it would take five years to get the navy into such condition that it would be a match for any first-class and perfectly appointed and disciplined navy, the Secretary in his annual report (this was before the war) gave the country to believe that our navy was in first-class condition and thoroughly prepared for eventualities. As a matter of fact the war found us in a woeful state of unpreparedness. What makes the Daniels' Administration even more subject to censure is the fact that for many months after our entry into the war there seems to have been no serious effort to make the fullest use of our ships, and prosecute the war with that unremitting zeal which the serious crisis demanded.

Very fine, and deserving of the highest praise, was the conduct of our officers and men, as soon as the departmental muzzle had been removed and they were given an opportunity to show what they could do. The work of the fleet was beyond praise. But in the interests of the navy of the future, it is our duty to warn the public against any impression that Mr. Daniels' book may give that in preparation for war, and in the first few months of effort after we entered the war, Mr. Daniels and those whom he had gathered round him, proved themselves to be qualified for the stupendous task with which they were confronted.

Massachusetts "Tech" in the Gliding Contest

ALL America will wish God-speed to the three students of the Massachusetts Institute of Technology, who at the present writing are on their way to the International Gliding Contest in France, where they will pit their little eighty-pound flier against sixty entries representing the best that France and Germany can produce. Strange to relate, this new form of sport is a legacy of the war, or rather of the Versailles Treaty, according to the terms of which the Germans, being forbidden to build motor-driven airplanes, turned to the development of the glider. In this comparatively unexplored field of aviation they have secured some remarkable successes, notably in the competition last Fall, when the best machine covered a distance of approximately fifteen miles.

The trio who will represent the Aeronautical Engineering Society of the Massachusetts Institute of Technology are, of course, students of that institution, one of them being the designer of the machine, another its constructor, and the third the pilot, formerly a test pilot for the Army Air Service at McCook Field, Dayton. Although it is perhaps too much to expect that our entry can carry off the prize against a field which is certain to include several veterans in the art of gliding, this maiden venture of the United States starts out under excellent auspices; for the institute has for many years provided a course in aeronautics which affords full facilities for the study of the art, including that absolute essential the "wind tunnel." Our boys, therefore, are no mere amateurs, and their machine will embody every good feature that theoretical training, practical construction, and wide experience in the air, on the part of the pilot, can afford.

The American glider, with a span of 24 ft., and a chord of 4 ft. 9 in., weighs, as we have said, only 80 pounds. Compare this with the most successful of the German gliders, which weighs 149 pounds. Gliding is essentially a contest with gravity, and in this regard the American machine is well placed. The flights will be started from the top of a mountain 4700 feet above sea level, and, other things being equal, the contest will be won by the flyer who possesses in the largest degree that instinct by which the soaring birds are able to find and float upon the ascending currents of air.

Evidently the remarkable success achieved by the Germans in gliding has made a profound impression in Europe, as is shown by the fact that in addition to our own entry there will be teams from France, England, Switzerland, Italy, Spain, Holland, and Norway. The prizes are generous, amounting to a total of one hundred thousand francs.

We should welcome the motorless airplane as the latest and most promising recruit in the field of international sport; for unless it should develop unexpected range and controllability it is difficult to see any future for the glider as a military machine. So much the better; for in the present condition of war-weariness, in the inevitable reaction from the perfervid interest with which, for many years, we followed the development of weapons designed only to kill, it is refreshing to find in the glider a machine whose purpose is peaceful, and whose province is to furnish a fascinating form of contest.

American and British Destroyers Compared

IT is a favorite saying of Admiral Sims that there is nothing so helpful to progress as honest constructive criticism, and in this we thoroughly agree with him. When a man, or a body of men, reach a point at which anything they may do becomes in their eyes superlatively good, all hope of progress has vanished. The gallant Admiral is famous for his fearless criticisms of anything which is wrong with the United States Navy, and which needs to be quickly righted; and in this patriotic and courageous attitude he is not alone. The case in point is an article in the last number of the proceedings of the United States Naval Institute, in which Lieutenant T. Chandler of our Navy compares American and British destroyers in regard to their seaworthiness, gun-power, and all-round proficiency. His chief count against our boats is that they are under-gunned, and that, because two of the 4-inch guns are placed abreast of each other, there are only three guns available on each broadside.

This matter was referred to, it will be remembered, in our last issue, where we showed a proposal to rectify this matter by carrying eight guns in pairs, mounted on four pedestals. Lieutenant Chandler points out that it is a strange anomaly that we, who are the originators of the centerline position for all guns—as witness, the "Michigan" and "South Carolina"—should have departed from this arrangement in the three hundred or more first-class destroyers which we built during and since the war. However, this is a matter which doubtless can be changed by bringing the two broadside guns on to the centerline, a change which, while it might tax the ingenuity of our naval constructors and ordnance officers, could doubtless be made.

In respect to seaworthiness in heavy weather, Lieutenant Chandler states that under average conditions the American "flush-deckers" are good sea boats with a slow roll which is favorable to gun practise. They do less well, however, when driving into a moderate sea at speeds of 20 knots or over. The British destroyers were designed mainly for constant work with the grand fleet under the hard conditions of the North Sea, and are built of heavier scantling than our boats; they are also provided with a wide flaring bow, a feature which we have embodied in our latest battleships, but have used only in a very modified form in our destroyers. As a result of the North Sea experience, it was determined by the Admiralty that destroyers that were intended to accompany the fleet should be capable of making twenty-five knots in any weather in which a battleship could proceed under full power, and fight her guns.

The speed of our boats as a whole is somewhat greater than that of the British destroyers. When it comes to the torpedo armament, however, our boats show a great superiority, inasmuch as they carry twelve torpedo tubes, six on each broadside. Tubes that are mounted outboard, as ours are, can train through a wider arc than tubes on the centerline; for the torpedo after it has left the tube commences to fall, and it must clear the edge of the deck after being fired. Hence, tubes mounted on the centerline, in the British fashion, cannot be fired many degrees ahead or astern of the beam, since the risk of hitting the edge of the deck increases with the angle of train.

Lieutenant Chandler is of the opinion that we should not build any more destroyers of the present type. "Homogeneity," he says, "is a valuable quality for the units of a force, but we must not sacrifice all progressive ideas to attain this end." He considers that if the hull be modified to give it greater strength and better seagoing qualities in heavy weather, and we return to the centerline position for the battery, our future destroyers can be placed in the same class with our other new construction, as being the best and most advanced in the world.

Something New in Locomotives

MANY attempts have been made to get rid of heavy reciprocating parts in the steam locomotive, and the problem has been attacked from many angles. Manifestly, the surest way to abolish the unbalanced weights and secure a perfectly even torque on the driving axles is to adopt the electric motor; and for local service, or even for moderately long-distance service, the electric locomotive, with its powerful acceleration, steady running and satisfactory fuel economy at the power station, is ideal.

But the greater part of the world's railway tracks calls for long-distance operation, on which the traffic is comparatively light and, therefore, does not justify the great initial cost of electrical equipment. Hence, the self-contained locomotive unit is destined, apparently, to hold its own for long-distance runs for many years to come. But the locomotive is an extravagant fuel burner, and many attempts have been made to incorporate the refined engine and boiler practice, which has so greatly reduced fuel costs in the best land power stations and in marine practise. As evidence of marine economy, we may mention that twenty years ago we were given free access to the engineer's log during an Atlantic passage, and found that the consumption for the main engines of 33,000 horsepower was only 1.33 pounds per horsepower per hour.

The latest attempt in this direction is seen in the Ramsay locomotive, in which a steam turbine is substituted for the reciprocating engine, and the exhaust steam is passed through a condenser, the water being returned to the boiler as in marine practise. Both in theory and (we are told) in actual service, this locomotive shows marked economy in fuel and water consumption, and it runs with the freedom from vibration of the electric locomotive. The searching tests in service which are now being made will be followed with close attention in railway circles, both here and abroad. The growing scarcity and high cost of fuel render such experiments as this of prime importance. It is not tolerable that the locomotive should be burning up several pounds of coal per horsepower per hour, when stationary and marine engines are using one and a half pounds, and in special plants have reduced consumption to one pound per horsepower per hour.

Armstrong's Super-Regenerative Receiver

WE have come to another milestone in radio progress. This time it is the super-regenerative receiver invented by Major Edwin H. Armstrong who, as the inventor of the regenerative circuit, the feed-back, and other improvements in vacuum tube receivers and transmitters, is one of the outstanding figures in radio history.

The potentialities of the super-regenerative receiver are enormous, and, indeed, threaten to revolutionize present radio practice. The fact that the new receiving arrangement, known as the super-regenerative receiver, is 100,000 times more sensitive than the regenerative receiver, means a good deal in radio. Furthermore, it must be remembered that Armstrong's regenerative receiver, now so widely employed, is ever so much more sensitive than the ordinary vacuum tube receiver. The receiver can be worked on very short waves, well below 200 meters, thus opening up a new field of wave lengths for radio-phone broadcasting. It makes indoor loop antennae practical, so that the outdoor antennae must soon disappear.

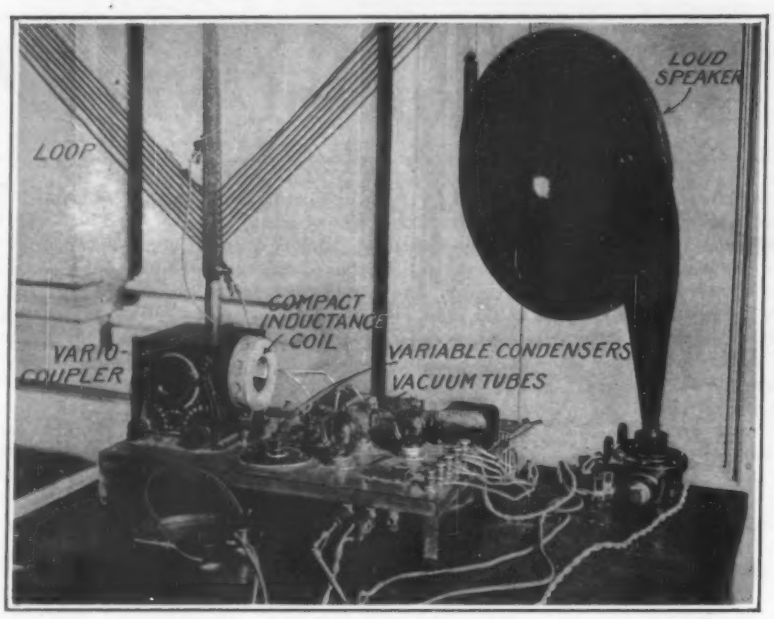
The principle of the super-regenerative receiver can only be explained by delving into the deepest kind of radio phraseology, and such explanations are beyond our editorial scope. The general principle, however, may be readily explained as follows:

Consider the usual regenerative receiving set. Incoming signals are applied between the grid and the filament of the tube, and the oscillations are amplified in the tube as a result, so that we obtain very much greater variations in the plate circuit. Now, if the plate circuit is coupled back to the grid circuit, the reinforced oscillations are fed back to the grid and, in turn, once more go through the amplifying process and cause still greater variations in the plate circuit, and so on, over and over again. The regenerative process increases the sensitiveness of a single vacuum tube detector enormously, making it possible for the well-equipped radio amateur to pick up radio-phone stations at hundreds of miles and even thousands of miles distant.

The regenerative process, however, can be brought up just so far and no further. As the regenerative action or feed-back action is increased, the sounds in the telephone receivers or loud-speaking device become louder and louder, but suddenly the arrangement breaks down and the sounds, while still louder, become mushy and distorted. The radio-phone speaker's voice, so clear and loud up to this point, now becomes a mere gibberish. The reason is that the detector tube has begun oscillating and is putting out its own oscillations which interfere with and break up the received radio-phone waves. If the oscillating condition could be overcome, the regenerative or feed-back action could be still further increased, with a very great gain in sound strength.

It has remained for Major Armstrong to get around the usual oscillating point of the tube. As the regenerative action takes place in the usual tube, the resistance of the circuit, as far as the radio frequency current is concerned, approaches zero. If the tube can be kept from oscillating, the effective resistance gets down to absolute zero and even less than zero, and takes on a negative resistance. In his super-regenerative receiver Major Armstrong increases the coupling between the grid and plate circuits so that the tube is far beyond the oscillating point and the effective resistance of the circuit is less than zero, having a negative resistance. He puts a stop to the oscillations so that he can take advantage of the negative resistance and in this manner obtains signals or sounds of heretofore undreamt-of strength.

The accompanying illustration depicts the set employed by Major Armstrong in demonstrating his new receiver before the Institute of Radio Engineers in New York City. It makes use of a vario-coupler, a duo-lateral coil, two Seibt type variable condensers, three Western Electric type vacuum tubes, fixed condensers, "B" batteries, filament battery, loud-speaker, and various accessories. Numerous amateurs, who have seen the "hook-ups" of the new Armstrong circuit in the various radio periodicals, have endeavored to build a super-regenerative receiver. In the absence of exact data, however, it appears that this receiver is far more of a Chinese puzzle than any problem so far faced in the annals of amateur radio.



General arrangement of standard radio instruments and loop for the Armstrong super-regenerative receiver, using a loud-speaker

A Helicopter that Flies—The Berliner Machine

AFTER nearly 20 years of search, research and experimentation, the famous inventor, Emile Berliner of Washington, D. C., and his son, Henry A. Berliner, have perfected the first successful helicopter which will rise perpendicularly from the ground, and when it has reached the desired elevation will fly ahead at whatever speed the operator wishes.

The flying helicopter rises straight from the ground in its aerial ascent toward the clouds. After it arrives at the desired altitude, the aviator can direct its course whichever way he desires by tilting it forward so that it will fly horizontally. This tilting is accomplished by a small horizontal propeller which is 3½ feet in diameter and located at the tail end of the machine. By manipulating this propeller the necessary tilt of the helicopter is obtained. Under circumstances where the tilting propeller is inclined at an angle of 15 degrees a loss in the lifting power of but 3 per cent occurs. This results in the production of a horizontal push which is equivalent to over 25 per cent of the lifting power.

During the last few months Mr. Henry Berliner has flown the new and novel helicopter regularly on the aviation field at College Park, Maryland, where all the test flights have been made. The machine with the aviator weighs 1325 pounds. The two lifting propellers are two-bladed and 14 feet in diameter. During the tests the helicopter has not been operated at heights greater than 15 to 20 feet above the ground, and as a rule it has been flown at a speed of about 20 miles an hour. At this writing, devices have not been perfected which will permit of the helicopter descending successfully from extremely high altitudes. Mr. Henry Berliner is now devoting his time to the development of such equipment which will make this curious helicopter safe and air-worthy. However, with a thoroughly dependable motor, the aviator can descend from high altitudes in safety by proper throttling.

Many other inventors have attempted to perfect a helicopter which would fly horizontally, but about the best they have done was to develop machines which would rise from the ground, but which failed in their efforts to fly forward on even keel after reaching a certain altitude. The discovery of the means of obtaining forward motion is the remarkable feature of the new Berliner machine.

It was in 1905 or thereabouts that Emile Berliner began to experiment with the idea of perfecting a helicopter. He had two lightweight revolving cylinder motors—the first of their kind—built. One of these motors is on exhibition in the United States National Museum. By June, 1909, Mr. Berliner had succeeded several times in lifting a man in one of the early types of helicopters which he devised. However, such elevation was accomplished only by jerks and jumps instead of being effected uniformly and gradually. Some time later, Mr. Berliner was overtaken by a nervous illness which obliged him to abandon his research activities. In the meantime, his youngest son, Henry, completed the technical course at Massachusetts Institute of Technology, after having previously attended Cornell University for two years. The young man was particularly adept in working out intricate riddles, in addition to being a skilful designer. Ultimately, his father entrusted him with the problem of working out mathematically a helicopter type of flying machine which would steadily lift a man and fly forward by tilting the machine. Young Berliner spent several months in constructing a scientific testing apparatus with which he tried out various types of small lifting propellers singly as well as in groups. Finally, he designed and built the first helicopter apparatus which proved practical. The initial machine weighed 570 pounds, while the revolving cylinder motor was an 80-horsepower affair. The two propellors were 13 feet in diameter and 10 inches wide, and the aggregate lift amounted to approximately 900 pounds, equivalent to 60 pounds per square foot of effective lifting surface.

The body of the most recent design of helicopter developed by Henry Berliner is somewhat like that of an ordinary airplane. In the front on either side are the lifting propellers, each of which is 14 feet in length. They revolve in opposite directions and are operated by means of a revolving motor of 110 horsepower placed in front of the driver's seat. There are triple fins at each end of the machine to control the side balance of the helicopter when the wind is gusty. By placing ordinary hydroplane floats under the machine, it can be converted readily into a "hydrocopter" which will be qualified to rise straight up from the water instead of having to make long runs on the surface previous to taking the air. Under such conditions, the latest Berliner invention—it is a fitting successor to the gramophone and the loose contact transmitter, which made industrial telephony possible, and the many other valuable contributions of Emile Berliner to the industries, arts and sciences—may be used satisfactorily either on land or water.

The present flying helicopter was designed and built by young Mr. Berliner, incorporating his father's ideas.

Berliner's helicopter during tests at College Park, Maryland, where the machine rose vertically from the ground and flew horizontally at the desired elevation

The first successful helicopter

A Pump That Converts Any Automobile Into a Fire Engine

OUT of Italy have come many notable improvements in mechanical engineering; and here we show a portable turbine pump, designed by Mario Tamini, which has such great capacity for its small size and weight, that it has made an immediate appeal to the Fire Departments of the leading European cities. The light weight of the pump is shown by comparison with a standard centrifugal pump, with circumferential discharge, which at 1750 R.P.M. at 88 lbs. pressure, delivers 500 gals. per minute, the weight of such a pump being 1600 pounds. A Tamini pump, at the same R.P.M. and 105 pounds pressure, delivers 750 gals. per minute, the weight of the pump being only 250 pounds.

The secret of this saving of weight is to be found in the fact that, instead of the impellers discharging to a large and heavy outlet formed around the periphery, the discharge is into passageways formed within the casing on both sides of the impeller, with final discharge outlets on one side of the pump. Thereby the diameter is greatly reduced, and also the width of the whole casing. This results in a great reduction of weight, which is further assisted by the substitution of gunmetal for cast iron.

As shown in the accompanying cross section, the pump is of the two-stage type, with the impellers back to back.

Into the inlet pipe (a) is inserted the pump shaft (b) on which the impeller or running portion is mounted. The impeller is double and comprises two helical blade groups (c) and (d) separated from each other by a web (e) which fulfils the duty of stiffening arms, the two groups of blades with the separating web forming virtually two distinct impellers with centrifugal circulation.

The outer ends of the passages formed by the helical blades within the rotors (c) and (d) deliver into a peripheral casing, to which are alternately connected sets of guiding passages (f) and (g). The passages of the two sets run in opposite directions and are formed by helical surfaces; the passages of the set (f) receive the liquid from the rotor (c) and convey it into the channels (h) of the casing by which the rotor (d) is fed, whereas the passages of the set (g) receive the liquid from the rotor (d) and convey it to the outlet or outlets (i) provided in the casing. The priming of the pump is effected by two vacuum pumps carried at the back of the pump casing.

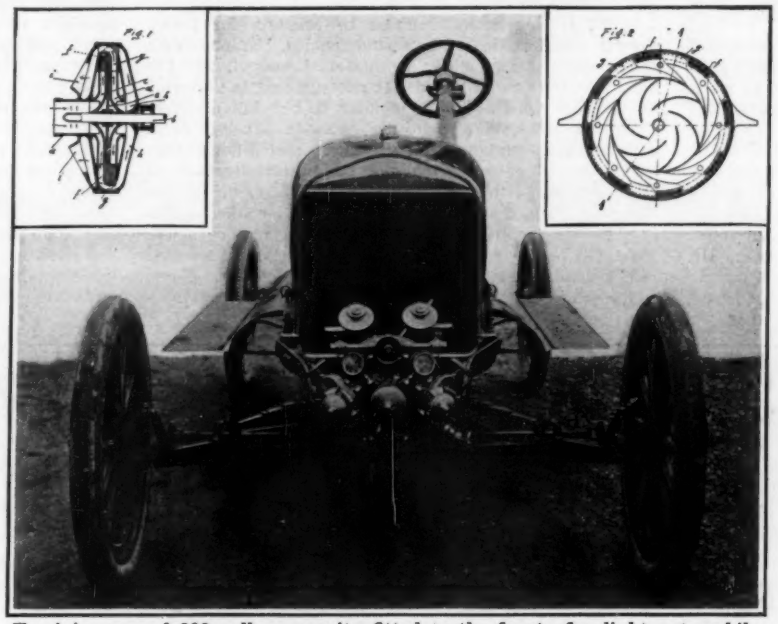
For use in fire fighting, the pump has been so designed that it can be attached to the front end of any automobile. It rests by two side lugs upon the chassis, to which it is firmly bolted, the pump shaft being lined up with the engine shaft, with which it is thrown into or out of gear by a clutch. Where the engine speed is low, suitable gearing is provided to bring the pump up to the required speed.

Our illustrations show a pump of 200 gals. capacity thus fitted to a Ford car. The two vacuum pumps serve to lift the water from a pond, well, or other source of supply, thus enabling the pump to make an immediate start, the limit of lift being about 28 feet.

Our other illustration shows a self-contained outfit consisting of an engine and pump mounted on a pair of wheels, and used as a trailer. A Ford car carrying its own 200-gallon pump can haul a trailer with a capacity of another 500 gallons per minute, at a speed of 20 to 25 miles per hour. The trailer has the advantage that, because of its lightness, it can be drawn by the firemen over soft ground or ploughed fields; which would be impassable to a motor car. For city work, large pumps and more powerful cars are used, the largest capacity being the 750 gals. per minute unit referred to above. Apart from the advantage of light weight and large capacity, which are of great value in fire-fighting, the pump has the following advantages:

First, remarkable simplicity of construction and complete absence of valves and close-working surfaces; conditions which permit the pump to use muddy or gritty water. Second, a wide range of capacity, giving good results, whatever may be the source of water supply. Third, a total absence of pulsation and vibration, thereby prolonging the life of the suction and delivery hose. Fourth, due to the two air pumps, which are used only for a few seconds, the water is at once available from vertical lifts of 26 to 28 feet.

Self-contained fire-fighting unit comprising a gasoline engine and a Tamini type pump, which can be used as a trailer



Tamini pump of 200-gallon capacity fitted to the front of a light automobile, and two drawings of the pump mechanism

Trying out a twin 4" mount for destroyers. This was rejected because of crowding at the breech, and interference of the two gun crews. A single 5" gun would be preferable

Adapting the Double-Barrel Idea to Naval Gunnery

DURING the war it was realized that the total broadside which could be delivered from the guns of our destroyers was not commensurate with the size of these vessels. They carried four 4-inch guns, one on the forecastle deck, one astern, and two amidships. The amidship guns were so mounted that, in broadside fire, one of them would necessarily be masked by the gun which was in action on the opposite side; consequently, the maximum broadside was that of three 4-inch guns. At that time many of the foreign destroyers were mounting four guns, all on the centerline; which, by the way, was a practice that was inaugurated in our own navy in the battleships "Michigan" and "South Carolina." This meant that although our destroyers carried the same number of guns as foreign destroyers of the same size and date, they could concentrate four guns on the broadside against our three.

Another consideration at that time was the question of increasing the total gun power of our largest destroyers, and two methods were proposed; one of which was to adopt the 5-inch instead of the 4-inch gun, and the other was to mount two 4-inch guns side by side on a single mount, thus increasing the total battery from four to eight such pieces. In favor of the 5-inch gun the point was urged that it was far more powerful than the 4-inch, and that some foreign navies had already mounted it upon the destroyers and flotilla leaders, or were about to do so. Against the 5-inch gun was the fact that in heavy weather, when the movements of rolling and pitching are very rapid, the heavier weight of the gun, and of its individual projectiles, would render it more difficult for the gun crews to handle.

In favor of the Twin-gun, 4-inch mounting, it was urged that the number of rounds per minute would be doubled, and that the stream of projectiles which could be thrown would be particularly effective in the quick, snappy, fighting which characterizes destroyer gun engagements.

In order to test out the system, some twin-mounts were built and tried out, and our illustration shows one of these twin-mounts in action. The experience had with them was not sufficiently satisfactory to justify their adoption, and the idea was abandoned. The particular drawbacks were, that there was an objectionable crowding of men around the breech of the guns, since two complete detachments had to be operating at top speed side by side. The right-hand gun breech mechanism swung open to the right, the left-hand gun to the left. The left-hand gun crew had to operate right-handed, and the right-hand gun crew had to operate left-handed; and as can be readily seen from our picture these men were thrown too closely together for perfect freedom of action. When the guns were given maximum training fore and aft, the crew of the outer gun were apt to be crowded off the edge of the deck.

Then, there was the objection that the two shells leaving the muzzle of the gun at the same instant, and in such close proximity, were liable to interfere with each other; for the instant the base of the shell cleared the muzzle of the gun there would escape from the muzzles, in a sideways direction, a blast of gases under a pressure of three or four tons to the square inch. And since, due to variations in the powder, one shell might leave a little before the other, the first shell would receive a powerful side-kick from the escaping gases of the second shell. This might easily cause a slight deflection, which would be greatly magnified at a distance of several thousand yards, and would thus destroy accuracy. Or, if the blast struck the shell on the nose, or on the base, it would tend to set up gyroscopic effects which also would tend to destroy accurate fire.

Ectoplasm and Ectoplasm Fakers

The Other Side of the Psychic Picture, as Seen by a Skeptic

By James Black

SPIRITISM seems to be as old as time; but the records are mainly of witchcraft and "black magic" until about the sixteenth century, when ghosts, specters and apparitions of a type similar to those of modern spiritism demand our attention. Early in the seventeenth century one Pierre le Loyer endeavored to formulate a science of specters. A little later reports of wonderful feats of levitation were current. For one of these Bishop Jeremy Taylor and Lord Orrey were sponsors; and Dr. Joseph Glanvill, F. R. S., records cases of spirit rapping, among them the famous Tedworth Drummer and the Little Burton Ghost. In this superstitious age, however, organized critical investigation was not to be expected; and these cases are of significance to us only through the suggestive fact that they always involved a central figure—a medium—associated with the phenomena, and in whose absence peace usually prevailed.

For about a century and a half spiritism developed rapidly from these beginnings. The visiting spirits usually had an object in view—to solve a murder, to warn of death, in one case to collect a debt of 90 cents; and this accomplished, they usually withdrew. But the Cock Lane Ghost episode, of 1762, provided a check to the growth of spiritism. One Kay invoked the law to collect a debt from his landlord Parsons; and a retaliatory spirit promptly accused Kay of having poisoned his wife. Many people of note were interested, including Goldsmith, Walpole and Samuel Johnson. Dr. Johnson proved beyond all doubt that Parsons' daughter Elizabeth made the rappings with a piece of wood, while her mother, a ventriloquist, provided the spirit voices. The conviction and imprisonment of Parsons and his wife put spiritism under a cloud from which it emerged only in 1848.

Modern spiritism really started with the exhibition of rapping given by the Fox Sisters at Rochester in 1849. The vogue spread, and soon they had many imitators. Their methods were exposed by several well accredited investigators, the late Dr. Carpenter for one. Daniel Douglas Home, next on the list, escaped exposure—doubtless through his utter refusal to be investigated, save on one occasion when he failed to produce any phenomena while under test by the Dialectical Society of London. Levitation was his strong point. Much is made of the fact that Home did not perform for money; but the court records will show that he was obliged to restore some $300,000 which he had extorted from Mrs. Jane Lyon, a wealthy widow, whose husband "appeared" and instructed her to give up the money.

In spite of his complete failure to vindicate himself before the court, Home was considered genuine by many prominent men, notably Sir D. Brewster and Robert Dale Owen. But Brewster, within one week, wrote two highly contradictory opinions, the one appearing in Home's Life and the other in Brewster's own, and this may fairly be taken as disqualifying him; while Owen's incompetence as a judge is shown by the fact that in 1874 he reported the Thomas Brothers as entirely genuine, only to see them later caught faking the very acts on which he had passed. Owen's style of investigation is well illustrated by his circumstantial account of a man who died after breakfast in Rhenish Prussia, and appeared in the spirit to a friend in New York, before noon on the same day—several hours before his demise, after correcting for the time difference. All things considered, the court's opinion of Home is preferable to Brewster's or Owen's.

Other mediums followed in rapid succession, down to the notorious impostors Slade, Eglington and Palladino. Palladino is still cited as an exponent of true psychic phenomena, notwithstanding her exposures in Cambridge in 1895, and subsequently in New York. These exposures are calmly admitted, and the plea is advanced that when "her spirits failed her," her anxiety to produce results led her to resort to trickery. No explanation is offered for the facility with which she was always prepared for this necessity.

The Rev. Stainton-Moses, an "amateur," is worthy special mention. He performed only before friends, and neither he nor his controlling spirit "Imperator" would brook investigation. His phenomena were, on their face, quite remarkable, but are, of course, utterly without confirmation. And his logic was very bad; he resigned from the Society for Psychic Research when that body was at pains to prove that many well-known mediums were carrying previous convictions for swindling. In fact, spirits and professional mediums were getting so much into disrepute at this time that Frederick Myers said "It does not seem worth while, as a rule, to examine the testimony on psychical marvels occurring in the presence of professional mediums." A very significant statement from such an authority, and as true today as it was then.

Spirit circles were troubled to account for many ghostly peculiarities and inconsistencies. The visiting spirit would occasionally be material enough for his light foot-falls to be heard, yet not sufficiently material for a brick wall or a closed door to bar his passage. The rapping spirit's visibility was in inverse ratio with his noise-making ability. These and other things led to the effort to account for the materialization on some new basis, that would make the discrepancies less damning. The fraud and deceit that had walked hand-in-hand with spiritism since its inception were a big handicap to the researchers, but obviously if they had real spirits these must be made of something. Some suggested a mysterious force, others an ethereal substance; and the struggle to obtain harmony gave birth to a combination of the two theories and the present "ectoplasm" theory of spirit manifestations.

It will be in order to consider this theory, and the evidence in its favor, from a critical and judicial standpoint. Many reports of the remarkable nature of this substance are current, but little definite information is to be had. Vague generalities and the assurance that investigation has proved this to be a real and true phenomenon are not sufficient. To turn to the "scientists" who have done the investigating gives us interesting information, but involves us in hopeless contradiction.

All agree that ectoplasm is a plasma of psychic origin, extruding from the medium. Most add that it is the stuff of which perambulating spirits from the great beyond are made. It is unanimously possessed of some power or force that enables it to tip tables, rap floors, fabricate faces and limbs, and indulge in varied and remarkable phenomena. Here agreement ends; when our psychic friends endeavor to set out in scientific style the results of their research, and to state just what ectoplasm is and just what it does, it becomes plain that the investigations have been conducted in anything but a scientific manner; and any ordinary science student would be pardoned for considering that ectoplasm, in view of the nature of the evidence for it, is principally inflammation of the imagination.

Dr. Geley and Baron Schrenk-Notzing are the two most quoted authorities, with Dr. Crawford as a support. According to Dr. Geley, the plasma extrudes from the head of the medium in knobs, ribbons and fringes, of different colors; sometimes it is stiff and sometimes soft and elastic; and at all times it shrinks from any contacts. Yet Geley, with the assistance of Franck Kluski, a medium, took wax casts of ectoplasmic hands and feet! Dr. Crawford's ectoplasm extruded from the lower part only of his medium's body and would strike sledge hammer blows on the floor, lift tables and several times poked him in the ribs so forcibly that he likened it to being poked with the blunt end of a metal rod. Geley has it luminous, and the action of light causes it to be reabsorbed instantly by the medium. But Crawford in all his 87 experiments never saw the plasma, and is at pains to prove that it is neither luminous, phosphorescent nor fluorescent. Crawford and Doyle agree that the mystery stuff instantly dissolves in light, yet both Geley and Schrenk-Notzing have taken flashlight photographs of it.

The most alarming contradictions appear when the scientists come to the question of analysis. Geley states definitely that the plasma cannot be analyzed, for to detach a portion from the medium would "grievously harm and probably kill her. Then Schrenk-Notzing gives an analysis and the contents are reported as mainly cellular matter, such as is found in the mouth and throat. Stanley de Brathe, the translator of Geley's book, tells us that analysis shows the contents to be at least 50 per cent water, some sulfur and albumin, and gives the chemical formula as "something resembling" $C_{120}\ H_{1134}\ N_{218}\ S_2\ O_{240}$. This formula will be quite familiar to a chemist—but he will not call it ectoplasm. Lebiedzinski—a Polish scientist—has ectoplasm analyses showing the contents as fats and human cellular matter, and the appearance like that of well-beaten white of egg. Then, presumably to clear up any confusion of opinion, Conan Doyle assures us that science knows absolutely nothing about ectoplasm, and improves on this statement by adding that analysis proves it to be composed of carbonates, phosphates and other matter unknown to anyone!

A logical and scientific mind is absolutely unable to imagine such a mass of conflicting data passing under the name of scientific evidence. Try to imagine a substance that dissolves in light, yet does not do so; that can be analyzed, and cannot be analyzed; but when analyzed is found to consist of one assortment of elements, and also of several other very different assortments. That shrinks from all contacts but will throw tables and chairs around. That science knows nothing about; then promptly tells all about it! Sir Arthur Conan Doyle recently stated that scientists and psychic researchers were "scandalously skeptical" about ectoplasm. Need we echo anything about scandalous credulity?

Dr. Geley and Baron Schrenk-Notzing used the same medium in their research work, this medium being known as Eva Cariere. As the results of the research are being offered as a contribution to scientific knowledge, it is natural to look for a medium of unimpeachable integrity and for indications of the methods of science in the details of the researchers. Unfortunately we look in vain. Geley assures us that there was no possibility of trickery on the part of the medium, but he fails to mention any adequate precautionary measures that were adopted. When Schrenk-Notzing makes some attempt to guard against fraudulent methods the results indicate quite clearly that fraud was not only possible, but highly probable.

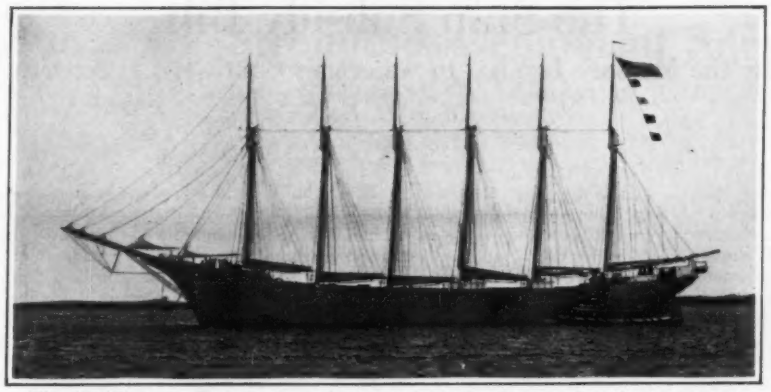
Dr. Geley's investigations took place in darkness. The medium took her place in a cabinet and went into a trance. Extrudations of the plasma began and were built up into spirit hands, faces and sometimes heads complete, topped with real hair through which Dr. Geley ran his fingers—forgetting for the moment that the plasma must not be touched. The heads and faces always appeared in the vicinity of the medium, in no case more than 27 inches from the cabinet—just about arm's length. The development of the plasma took place *behind the curtain of the cabinet.* The partly formed head or face would suddenly appear in an opening of the curtain, disappear and then reappear

(Continued on page 215)

LAST month Mr. Black put forward the evidence, hinted at by Dr. Prince in our issue of July, against spirit photography. We believe there is little ground for taking any other view toward this phenomenon than that it is always fraudulent—the opportunities for fraud in modern trick photography are in any event such as to make it practically impossible to establish these pictures on any basis other than that of blind credulity. This month we give Mr. Black space to set down the very considerable body of evidence against another of the current psychic manifestations. Here we think the psychic may have a better defense. But he must defend: Mr. Black's criticisms must be met, and not side-stepped. It is true, as he says, that most professional mediums have very bad records; that intelligent precaution against fraud seems to be a strong inhibitive of ectoplastic action; and that the average psychic believer loses whatever sense of scientific method he may ever have possessed. These facts are of course not necessarily conclusive against the validity of all ectoplasm, but they are certainly something to be explained rather than deliberately ignored or explained away.—THE EDITOR.

The Limit of Size for American Schooners

THE American fore-and-aft schooner holds a place in the public interest and admiration, second only to that which the famous square-rigged clipper ships of the '50s and '60s won for themselves on all the sailing routes of the world. The fore-and-after we have had with us from the earliest times, although in Revolutionary days and for some years thereafter the schooner was liable to have more or less of a square rig on her foremast. This type, however, was better known in Europe than in the new world, and still survives.



The "William L. Douglas," a six-masted steel schooner for the transport of bulk cargoes

For several decades the American schooners have sailed mainly in the coasting trade, although occasionally they have slipped out of port for voyages which have carried them to the ends of the earth. Our preference for the schooner has been based mainly upon economical considerations. Because of the simplicity of her rig and gear she can be handled by a much smaller crew than is necessary upon a square-rigger of the same tonnage. If it be urged that, with the wind over the counter or dead aft, she cannot hold her own with the square-rigged ship, her skipper will tell you that when it comes to getting the sheets hard inboard and making a drive to weather, she will point much higher and make a far better day's work of it than the older type. For many years the coasting schooner carried her sailspread upon two masts only. Then, as the size of the ships increased, a third mast was added. The three-master proved so successful that the four-master made its appearance, and, although shipbuilders did not realize it at that time, the four-masted vessel is now recognized as the ideal type for all-round service.

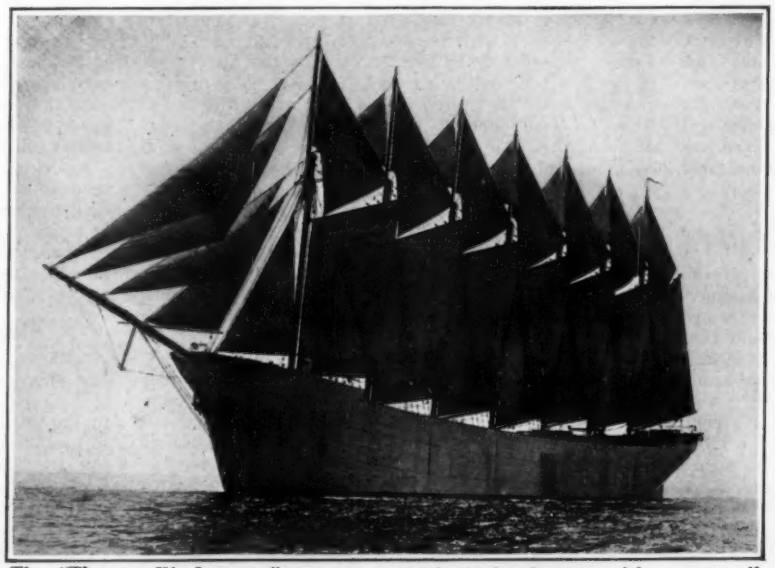
It was inevitable, however, that the success of the four-master would tempt the shipbuilders of the excellent yards on the Maine coast and up the Maine rivers to build in larger sizes yet; and so, successively, there appeared the five-master, and then the six-masted wooden sailing ship. But this was going too far, and these big fellows made heavy going of it if they fell in with bad weather, and from time to time they would loosen up and founder, while many of them were lost upon a lee shore.

Before abandoning the idea of building these huge schooners, it was decided to try what could be done in steel, and our illustrations show two fine steel vessels, the "William L. Douglas," a six-master, and the "Thomas W. Lawson," with seven masts. The last named will remain probably for all time the largest fore-and-aft ship that was ever built and hoisted sail. The dimensions and particulars of the "Lawson" will always be of interest to nautical men. Her length on the waterline was 369 feet 3 inches and overall she measured 403 feet 4 inches. Her beam was very moderate for a ship of this length, being only 50 feet. Her molded depth was 35 feet 2 inches, and when down to her extreme draft she could carry 8100 tons of deadweight cargo. Her gross tonnage was 5218. Her masting was, of course, on a great scale; the six lower masts measured 135 feet overall, and the Oregon pine top masts measured 58 feet. The topmast head of all seven masts was 155 feet above the deck. The steel bowsprit was 85 feet long. It should be mentioned that the lower masts measured 32 inches in diameter, and each weighed 20 tons. To hold such huge spars in place the standing rigging had to be very heavy. Thus, the foremast had on each side five 4¾-inch steel wire shrouds, and there were four similar shrouds on each side for the other six masts.

The ship was built of steel throughout, and she was unique in possessing a complete double bottom, which was 4 feet in depth. The design was from the board of that talented yachting designer, B. B. Crowninshield, who it will be remembered was the designer of the "Independence," which raced against the "Columbia" as a competitor for the honor of defending America's cup. The "Lawson" was very strongly built throughout, and classed A-1 at Lloyds. Her cost was estimated at $250,000.

When it is stated that the ship spread 43,000 square feet of canvas, and the great size of the spars is borne in mind, it will be understood that steam power was necessary for the proper handling of the sails. For this purpose there was a double-cylinder engine in the forward deckhouse, with cylinders 9 inches by 10 inches, and five 8-inch by 8-inch hoisting engines were placed at intervals along the decks. The 5-ton anchors were handled by a windlass operated by a 40-horsepower engine. In spite of her great size a crew of sixteen was sufficient to handle the ship.

The "Thomas W. Lawson" was not considered to be a thorough success. This was not due to any fault of construction, for both this ship and the six-master "William L. Douglas" were built at the Fore River yards, from which some of the finest ships of our navy have been turned out. The trouble was apparently that she was too big for efficient handling under a fore-and-aft rig. She was lost many years ago, when light, in heavy weather off the British coast.



The "Thomas W. Lawson," a seven-masted steel schooner with an overall length of 403 feet 4 inches and a beam of 50 feet

German Engine Uses Naphthalene

A NAPHTHALENE engine for stationary purposes is being manufactured in Germany. The naphthalene is kept in the liquid state by means of steam generated by the exhaust gases, both the naphthalene container and the feed passage being surrounded with a steam jacket. Naphthalene at present costs only about half as much as benzol, the conventional liquid hydrocarbon fuel in Germany, on the weight basis. The engine must be warmed up with benzol or illuminating gas, and in the case of a 20-horsepower engine it is necessary to run 15 minutes on this auxiliary fuel to secure the initial heat desired for the naphthalene, after which there is no further trouble.

The Gasoline Rail Coach

THE independent, self-propelled, railway car is not by any means a novel idea. We have shown several such cars during the past twenty years. They have been built and operated in various parts of the world, some of them being steam-driven, and others having a specially designed gas engine drive. In most cases these were equal in size and weight to the standard railway cars, and in the majority of cases they were specially designed throughout, and were heavy and powerful units.

At last we have the real gasoline rail coach, which is designed and constructed for railroading, instead of an improvised motor truck coach with flanged wheels

The present revival of interest in this subject is due to the development of the motor car and the motor truck. In the early designs, the standard engine and transmission of a motor car was utilized with very little change; in fact, the first attempts were nothing more or less than a motor truck provided with a large capacity coach, with flanged wheels substituted for the ordinary rubber tires. In the later designs, however, such as the White rail coach herewith illustrated, the whole unit is a new design throughout, except that the motor and transmission are identical with those used in the maker's motor truck; the engine, clutch, and transmission, being embodied as a unit power plant. The operating controls are located on the extreme forward right-hand side of the coach. The foot-throttle, clutch, and drive-shaft brackets are operated by pedals. The rear wheel brake, and sanding mechanism are controlled by levers, and the brackets on the pivotal brake by hand-wheel. Means are provided in the rear of the coach for disengaging the clutch and applying the brakes in emergency. The rear wheels are all fitted with locomotive type steel flanges, and annular ball-bearings. The front of the car is carried on a four-wheel truck. The car can seat forty-one passengers, and the speed is governed to thirty-three miles per hour.

Railroad men are watching the development of cars of this and similar types with very close interest, recognizing that they offer an opportunity for giving travelers over short branch lines a better service, at a cost far below that of steam operation. These short lines do not operate a sufficient number of locomotives to warrant maintaining a locomotive repair, or machine shop. The Union Transportation Company, which operates twenty-five miles of track between Pemberton and Hightstown, N. J., determined to test the new system, and ordered a 29-passenger car, which has been making five round trips a day for a total of 150 miles, at a gasoline consumption of about 6½ miles a gallon. The traveling public took to the rail car at once and showed a preference for it over the steam trains; consequently, an order was given for the 41-passenger, which, in spite of its ability to operate independently, cost considerably less than a first-class steam train passenger coach.

The Ship Subsidy Bill

Why the Measure Is Vital to America's Continued Prosperity

By Albert D. Lasker
Chairman, United States Shipping Board

IMMEDIATE passage of the merchant marine legislation pending in Congress is of prime importance to every American. None can be excepted. The farmer, the factory owner, and worker, the merchant, the importer, the exporter, the railroad man, the consumer, the taxpayer, the man on salary, the man working for a daily wage, even the little child who is to be the citizen of the future, are directly concerned in this the most important measure before the national law makers. The time for action is here. The need of a comprehensive law to put the American flag back on the seas and keep it there is imperative.

The United States is the leading nation in the world today. It is the largest creditor nation. Its people have recovered most quickly from the devastating effect of war. Its future holds not only the hopes of its own 110,000,000 citizens, but the hopes of millions of other human beings in all parts of the world. Its continued prosperity is essential to the preservation of civilization. World trade has reached and passed its ebb and is now setting toward the flood. For us to continue prosperous, to help the weaker nations, we must hold our share of that trade. Our standards of living not only must be maintained at home but must be extended wherever possible. Our machinery of efficient production must be worked to its maximum for the benefit of all.

Peace must prevail if world trade is to survive. The existence of an adequate American merchant marine will assure peace by its very power. The existence of an adequate American merchant marine will bring to every nation a part of our prosperity as well as continue our own. The pending merchant marine legislation, carefully worked out by experts and thoroughly threshed over in the joint Congress committee hearings, offers a solution of the most unusual economic problem faced by the United States since the Civil War. The plan being urged by President Harding at one stroke would make permanently effective the work of the Limitation of Armament Conference. It would end within a short time the drain on the Treasury of $50,000,000 yearly spent in Government operation of government owned ships. Within ten years or before the naval holiday is ended, it would create a well balanced merchant fleet that would be a much needed auxiliary to our curtailed Navy, without crippling our powers of defense and without stirring the antagonism of our commercial rivals. By providing ample shipping, our producers, be they farmers, the miners or the factory workers, would find markets for the products of their labor and their resultant prosperity would be passed on to all other classes of our citizenry.

The legislation in Washington stands in a unique position. It has the support of both Democrats and Republicans. The record of the hearings before the joint Congress committee shows that hundreds of commercial organizations have recognized its value and urged its passage and not one body of business men has passed resolutions against it being made law. Its opponents on record are few. Their arguments are strangely at variance with the undenied facts or are based on premises changed by World War conditions and the commercial upheaval that was the aftermath of that titanic struggle.

The bulk of our population is rural and the farmer is most directly concerned with legislation of such wide national scope. J. R. Howard, president of the American Farm Bureau Federation, having a membership of a million and a quarter farmers, is on record as favoring the ship bill. He appeared before the joint committee and urged Government aid to American shipping until the American merchant marine is firmly established again on the seas.

The American Federation of Labor's executive committee opposed the bill, although many of its constituent organizations favored it. Among these were bodies representing more than 25,000 marine workers of all classes.

During the hearings an effort was made to show that the American merchant marine could exist without Government aid, but this fallacious argument was predicated solely on the high war profits made by one or two steamship companies and on the combined profits made by other companies that transported their own products in their own ships as an incident of their business. Comprehensive tables of actual operating costs of ships today prove conclusively that there is a distinct differential against the American owner, not alone in the cost of construction but also in wages and subsistence of officers and men. If the American standard of living is to be maintained at sea three differentials in capital and operating costs must be met in some way.

Certain administrative features of the bill have been attacked, but the critics have not seen fit to advance any constructive suggestion to take the place of the features they condemn. One clause that stirred especial comment was the one permitting the Shipping Board to increase or decrease the amount of direct aid paid any ship. The need for this provision rests in the facts that pioneer routes need greater encouragement, that foreign competition is fluctuating and keener on some routes that on others, while on some routes the schedule may be too high. It would be impossible to set a hard and fast rule of compensation and accomplish the full purpose for which the bill has been drawn. Flexibility is essential to its success. There is no danger to the public in such discretionary power being given to the Shipping Board, because it is provided that this discretion may not be exercised by any individual member of the board, but must be concurred in by at least five.

Insidious influences, which could not be traced, also have been observed, but these have not developed to the stage of argument, being concentrated on obtaining delay in consideration of the measure.

Of course it is impossible to tell just how much the merchant marine bill will cost, because its provisions have not yet been tried. Some of its enemies seek to insinuate it will plunge the Government into an expense greater than the annual Shipping Board deficit is now—namely, $50,000,000. As close calculation as can be made shows that even if the greater part of the Shipping Board vessels now operating are sold almost immediately to private owners, the direct cost in the first year will be under $15,000,000. The experts calculating on the United States having a well-balanced fleet of 7,500,000 tons in five years from the enactment of the bill, figure that the direct aid provisions commonly called the subsidy will not at that time exceed $30,000,000 a year.

Why the merchant marine bill is vital to national defense may be said in a very few words. Great Britain possesses 136 steamships of 16 or more knots, against 45 of ours. Japan has authorized a merchant ship building fund of 250,000,000 yen ($125,000,000), to be devoted to the construction of vessels of the fast passenger liner class. With our shipping bill's provisions in full operation we should have in a few years almost as many fast ships as Great Britain. As Admiral Mahan pointed out, sea power is not solely fighting power, and history has shown that no nation ever has survived by reason of its navy alone. The merchant fleet is the real backbone of any maritime power.

Another important—tremendously important—feature of the ship bill is the creation of an immediate market for a vast amount of Government tonnage now idle and rusting away. We cannot sell these ships under present economic conditions to American citizens, and if we were to sell them to our foreign competitors we would only place in their hands at a ridiculously low price the world market price of tonnage, weapons for a commercial war that would cripple us within the next generation. Government operation of ships has been proved impracticable. In so sensitive a business as ocean carrying every incentive of private operation is essential to success. Still another factor is that private operators would improve their fleets and replace their ships with better ones as invention provided more economical methods. No one, not even the most active opponents of the bill, has suggested that the United States build and operate the ships necessary to round out our merchant fleet to the well-balanced commercial machine it should be, and which is assured by reason of the scaled direct aids in the pending bill.

Every safeguard has been embodied in the measure to prevent profiteering under its terms, at the taxpayers' expense. The discretionary powers granted to the Shipping Board by the bill, in connection with the subsidy payments, have been drawn to the end that excessive profits may not accrue and that heavy earnings of ships receiving the payments will be refunded to the Government to the amount of the subsidy paid. The creation of the $125,000,000 construction loan fund for building new tonnage assures the proper "balancing" of the fleet, in that it permits private owners to build in American shipyards the type of vessels we most need. The operation of this fund also keeps alive the shipbuilder's art, now threatened by the withdrawal of warship construction under the terms of the Four-Power Naval Treaty. So depressed is the condition of American shipbuilding at present that the Newport News concern took the $7,000,000 job of reconditioning the Leviathan at close to actual cost, if not a small loss, merely to keep its organization together.

The income tax provision of the bill which remits to ships in American bottoms 5 per cent of the freight money should provide a constant supply of cargo for our ships. For every dollar which does not go into the Treasury under this provision there are $20 paid in freights to American ship owners. What the income tax on this freight money will be is impossible of calculation at this time, but it is bound to be of gigantic proportions if American ships carry even half of the American overseas commerce. Our ocean freight bills in 1921 exceeded $400,000,000. In the banner year of 1920 they were $880,000,000. It needs only a glance to see what retention of half of either of these sums means to the American people and the necessarily large income tax that would be collected.

While the United States possesses to day the nucleus of a splendid merchant marine it is lacking in many essential types of ships. In railroad terms we have too many freight cars; that is, we have too many slow, cargo-carrying vessels. We need a certain proportion of Pullmans, and passenger and refrigerator and flat cars, in order that our transportation unit be capable of taking care of all classes of business that come to it. It is here that the construction loan fund will prove most valuable in the long run.

America has shaken off much of the inertia in maritime affairs that followed the Civil War, and is fast realizing what success in shipping means to the nation at large. "American goods in American ships, manned by Americans" sums up the policy of progress that promises our continued prosperity, not only for ourselves but for generations to come.

WE know of no other commercial problem that has been the subject of more misunderstanding than the Ship Subsidy bill; and it is with very special pleasure, therefore, that we present this illuminating article by the Chairman of the United States Shipping Board. Wealthy as the United States may be, it cannot afford to throw to the winds fourteen million tons of shipping. The proposal to sell all our ships in the open market for what they will bring, would bring back to the Treasury so small a return, compared to the original cost of the ships, that we should be practically throwing the whole fleet into the discard. Mr. Lasker shows us that the Government has found in the Subsidy bill a means by which we can at once save our fleet and make it contribute to the national prosperity.—THE EDITOR.

Simple Cure for Slipping Fan Belt

ONE ingenious motorist who was troubled with a slipping belt cured the trouble by applying a little belt compound to the pulley surfaces. Belt compound, by the way, is a somewhat sticky substance that is used in machine shops, power plants and factories to insure the gripping of the pulley by the belt with sufficient force to transmit the power without slipping. Just a trifling amount of compound is enough for a fan belt. Often it may be obtained from a garage machine shop, but if not there, it will be found almost anywhere that belts are used. Such a small amount is required that it is not worth while to buy a can of it.

Our Strenuous Geological Survey—II

Some of the Incidents of Topographic Work that Are Not on the Program

By Guy Elliot Mitchell
United States Geological Survey

The skins of a pair of Mississippi diamond-back rattlers, killed by a Geological Survey engineer in the Yazoo delta

ACQUAINTANCE with the topographic maps of the United States Geological Survey is today much more general than it was ten years ago. Time was, when only the engineer knew of these maps and the wonderful service which they can give. But nowadays, whether it be the automobile that is responsible or whether it be simply the result of slow and tireless attempts of the Survey to make its work known, the average intelligent citizen has probably seen some of the handsome ten-cent quadrangles and used them in his work or in his play. Last month, in the first installment of this series, Mr. Mitchell told us how these maps are made; and his story indicated, we think, that a far greater proportion of the work is done in the field, and a far less fraction at the desk, than would have been the layman's offhand supposition. This month he looks at the same picture from another angle, and makes us acquainted with some of the lighter incidents of the topographer's routine. He surely shows us that adventure and excitement and real thrills are more a part of this game than the sober official reports of work accomplished would lead one to suspect.—THE EDITOR.

AFTER a 15-year association with the men of the Geological Survey, in the office and in the field, I have come to the conclusion that by far the most interesting three-quarters of their official reports is the untold portion. These men have adventures, but they do not recognize them as such. From an official point of view, this great trek of nine million miles in parties of from two to a dozen men, carrying heavy instruments, camp equipment and supplies, has always been such a commonplace affair that it is not considered worthy of mention. For instance, the topographic engineer has just returned from his completion of the survey of Mount Whitney quadrangle in California.

"Well, old man," I remarked, "how was the climbing this season?"

"Oh, fine exercise," he returned with a grin. "I am just beginning to ink in the old sheet, and I figure that we climbed a good 110,000 feet in three months." This is about seven times the height of Old Whitney; and, of course, this climbing represents the places where the horses and mules couldn't go because they don't grow claws.

"What about this photograph, Marshall?" I asked the former Chief Geographer, one day; "you seem to have had some trouble with the tripod of your instrument."

"Well, I should say I did," he replied, examining the picture reminiscently. "I was trying to get a sight from the summit of Post Peak in the Yosemite National Park, 10,990 feet above mean sea level, as I recall it. This was a slippery old granite boulder and the wind was blowing 40 miles a minute or thereabouts. We had to lash the legs of the tripod to keep it from blowing away. But what's the big idea? You are going to do something with those pictures, you old hypocrite! There you have that one of Hugh Ewell making a transit station on the Idaho-Montana boundary. That gnarled tree grew out horizontally from the face of the cliff, then turned downward and upward. It made a good station, though!" [The editor thought so—in fact, he thought sufficiently well of it to use it as the theme of this month's cover painting!]

"But what about the drop if Ewell had slipped?" I asked.

"Oh, get out," was the reply; "why are you fellows always talking about what *might* have happened? You have some fool magazine article on your mind or I miss my guess."

"Well, then," I said, "answer me one entirely rational question. How did Ewell get down to that snag and how did he climb up again after he had made his little sight!"

"Why, we lowered and raised him on a rope, of course," he replied.

"But suppose the rope had frayed on the edge of the rocks, and broken?"

"Clear out of here," retorted my friend; "I tell you, we have other things to do besides answering all your 'supposin' questions."

Many youngsters are taken into the Geological Survey, and they get their entire training in the organization. There was never, in fact, until the war, any other training school for the topographic engineer. And a mighty efficient training school this one is.

"How in the name of Sam Hill are we going to get across this river?" queries the new field assistant, on the bank of a rushing torrent. "There is no bridge within 50 miles and the mules can't swim it; the trees on the banks are not tall enough to reach across if we fell them. I'll bet the 'old man' is stumped this time."

A man quietly unlaces his hobnail boots and with a life-line around him, plunges in at the upper end of a bend in the river, striking out with strong strokes, but letting the current help him across. With the life-line he pulls over a stout rope, which is then fastened tight on both banks, making a strong cable with a loose running ring. A short rope is run through this ring and fastened to the girth of the first mule, and with another rope at his head he is shoved into the water and with the assistance of the swift current is rushed across. The other animals and the men follow in quick succession, and the last man unties the rope and is hauled across with it.

"Tomorrow," confides last year's assistant, "we will probably cross a torrent on a V-bridge. I'll tell you about a V-bridge. It's great. One tree won't span the stream, but two together will. So they pick out two trees on opposite banks and cut them so that they fall at the same moment, and both heading upstream. As they swing out with the current their branches will meet in midstream and interlock. The harder the pressure of the water on the interlacing boughs the better they will hold together. Do you get the idea? Both trunks point a little upstream. Across this we carry our outfit. We make the mules swim. The water runs over this shaky structure about a foot or so and we hang on by the limbs and the hobnails in our shoes."

Sometimes an engineer or a geologist lets out part of a good story without knowing it, or sometimes you may be able to read between the lines of a published report. In the completion of the survey of Mt. Rainier, Washington, the present Chief Topographic Engineer and other engineers who made the final ascent and survey of the peak at 14,408 feet encountered a terrific blizzard and if it had not been for the little Steam Caves a short way down the mountainside and into which they crawled and managed to keep each other awake until the blizzard subsided, they would undoubtedly have perished. As it was they were badly frostbitten, but after a couple of days they made the ascent again and finished the survey. The official statement of this experience was most commonplace. Another time when a small party was making a short side trip in the mountains with a little shelter tent, the thermometer being down nearly to freezing, a terrific wind storm came up in the night quite unexpectedly, and the next minute the tent was rooted out of its pegs, lifted up by the wind like a balloon and has not been found yet. Then the rain came down in torrents. Of course the men spent a highly enjoyable time the balance of the night. This is one of the few instances I have heard of when survey men seem to have been caught unprepared. The next day they joked over the incident, and the only official report made was that one tent had been destroyed by storm.

Survey party fording a mountain torrent with their equipment

Sometimes the topographic engineer works in pleasant places, and sometimes amid hardships which however make for ruggedness and afford pleasant retrospects; but again his duty calls him among swamps, mosquitoes, and pestilential regions where there is no fun at all. In the Yazoo delta surveys, in Mississippi, the tents were built in the shape of half houses entirely screened in with wire netting. This was a vast comfort at night when each engineer had several hours' work by lamplight. But in the daytime, the rattlesnakes! The prairie rattler and the timber rattler of the West have been declared not to be in the same class at all.

"Tell me something about these Mississippi rattlers," I inquired of a 6-foot 2-inch topographic engineer who had returned to Washington from an 8-month sojourn in the Yazoo. "John Muir describes a rare, great yellow rattler of California but unfortunately he does not give its dimensions. Are your rattlers as big as the great diamond-backs of Florida?"

"Well," he replied, "I don't know about either John Muir's or your Florida snakes; I thought I had seen wicked rattlers out West but they are nothing, and if your Florida variety is any bigger than the Mississippi kind I don't hanker to go surveying in Florida swamps. One day I was in a swampy, black bit of tangle on the edge of a bottomland cotton field. You know we had extra-long 8-foot legs on our tripods to compensate for their sinking in the soft muck. Well, I was just 'setting up' and had thrown out the farther leg of the tripod preparatory to leveling when there was a buzz like a sawmill and something about as big as an alligator launched out at the tripod leg. Almost simultaneously another something struck at the leg from the other side and immediately there was a battle royal on between the two worst snakes in America, the great swamp rattlesnake and the cotton-mouth moccasin. These two fellows usually let each other alone, but they were viciously at it this time, all on account of my innocent tripod leg. Both had struck at it at the same time and I guess they had struck each other. As for myself, I made a backward jump of 25 feet, I think it was. I should have been scientifically interested to see this unique battle fought to a finish, but the snakes were in my way so I poured a dose of shot into them at close quarters. The rattler was 8 feet 6 inches long and the moccasin, a much stubbier snake, was 4 feet 11 inches. If you don't believe the story ask 'Baldy' Johnston; he was along and he was all in a tremble for an hour after because you know these bloomin' rattlers are said to always go in pairs. We got the mate, too, by the way."

Speaking of snakes, my friend, the late Robert P. Chapman, was always a lover of rattlers; he wore a snakeskin belt and had a snake pocketbook, and in the field frequently had a pair of rattlers out near his tent, having first broken off their fangs. Chapman was a cultured, rather delicate looking man whom you would never suspect of being an explorer with any great powers of endurance. Yet he mapped the greater part

of Death Valley in California and the stretches of desert around about, lapping far over into Nevada and Arizona, the most awful region in the United States, where many men have perished miserably. Chapman and two assistants had a close call on this trip by getting too far away from their camp near Mormon Well and were saved when a rescuing party from the camp met them with canteens. Another year, Chapman was surveying in the Lewis and Clark National Forest in Montana. High up on the Swan Range, a goat trail that he was riding became too dangerous so he dismounted and led his animal. The snow-capped peaks were high above and a precipice yawned nearly a thousand feet below. The horse stumbled and fell, knocking Chapman down and rolling over on him—"I vowed then and there," he said, "that if I got out of that scrape alive I would never again ride anything in the mountains but a mule."

An early surveying party along the Yellowstone River, when a United States Cavalry escort was necessitated by the hostile Indians

Chapman's situation was perilous in the extreme; he realized the danger of becoming entangled in the trappings and being pushed or dragged over the cliff. He also knew the result of broken bones in these remote wilds if the horse in its struggles crushed him. The horse slowly got to its feet, miraculously leaving the man unharmed, clung desperately to the trail a moment by the calks of its shoes, slipped slowly backward, gave it up and went over the cliff. It struck the rocks below with a frightful scream and was broken to pieces. Almost every one of the older topographic engineers could tell you from one to a dozen similar stories of greater or lesser "experiences." But as one of the more imaginative of them once said to me "The adventure side of our nature has atrophied. Our whole training has been to get results, and to avoid, discount, and overcome dangers which interfere with the work."

Industrial Management

THE Seventh Annual Summer Session in Industrial Organization and Administration will be held at the Pennsylvania State College from August 28 to September 9 under the immediate direction of Professor Edward J. Kunze, assisted by Professors J. O. Keller and P. P. Henshall of the Department of Industrial Engineering.

The course is an intensive one, designed to meet the needs of manufacturers, superintendents, personnel directors, accountants, production managers and all others who pilot the affairs of industry.

Its purpose is to assist men in the development of their jobs, to broaden their horizon of the possibilities of the science of management and to illustrate to them by practical examples the most effective methods of modern organizations. It is not a theoretical resume of a batch of reading material, but rather a careful consideration of the theory in its application.

The work is divided into discussions on industrial organization, manufacturing methods, employment, industrial relations, factory planning, material and production control, scheduling and dispatching, purchasing, cost accounting, and kindred subjects. The greater portion of the time is devoted to practical installation methods, using the equipment of the five shops and the other facilities of the department that have been especially designed to handle this type of work.

Besides the discussions and laboratory applications, provision has been made for group conferences, a feature which last year brought forth so much favorable comment. The benefits to be derived from intimate contact with others whose problems are mutual and the valuable acquaintanceships formed make this group conference feature a very valuable one to all who participate.

The different lines of manufacture followed by those who have attended former sessions have been quite varied. Besides machinery in its various forms they have covered subjects from bridges to safety pins and from shirts to incubators.

It has been the custom for many companies to send one or more of their executive staff to attend the course and report back not only along the specific line of the attending executive, but also along such other lines as may indicate or provide solutions to needs of the company.

Bulletins describing the course may be obtained by addressing Professor Edward J. Kunze, State College, Pennsylvania.

Surveying with tripod legs lashed to the rocks to keep the instrument from blowing away

The Relative Toxicity of Strychnine to the Rat

THE results of a series of experiments on the toxicity of strychnine to the rat are compared, in U. S. Department of Agriculture Bulletin 1023, with the results which have heretofore been recognized for other animals or can be deduced for them from miscellaneous data in the literature. The comparative pharmacology of strychnine in mammals is outlined. The age (development) markedly influenced the toxicity of strychnine and the type of spasms produced. The rate of disposal of strychnine by the rat and its absorption from the stomach are discussed.

A topographic camp in Death Valley, Calif., after a violent storm

Mercury Poisoning

THERE is probably no industry, trade or art in which mercury is used but what has produced some cases of mercury poisoning, according to Dr. R. R. Sayers, chief surgeon of the U. S. Bureau of Mines. This is true of the mining and smelting of mercury, where the hazard has long been recognized. When the ore contains free mercury or the more soluble salts, and when the workings are underground and are poorly ventilated, cases occur, but there is a far greater number of cases among the employes about the reduction works. The frequency and severity of cases of mercury poisoning are far less with modern methods of mining and recovery of the metal than formerly. However, further reduction is possible and much can be done by both the workmen and the operators by following the proper precautionary measures. The cases of industrial mercury poisoning occurring about mines and reduction works are usually chronic in form, with occasional development of acute symptoms when the workmen are exposed to undue amounts of mercury vapors, dust, or soot. The cardinal symptoms of the disease are stomatitis (inflammation of the mouth), often with some salivation, tremors, and a peculiar timidity (erethism). These symptoms are accompanied by organic degenerative changes in various organs of the digestive system, the circulatory system and the kidneys. Insufficient or improper ventilation of the working places, together with failure to maintain sufficient back pressure to prevent the escape of mercury vapor from furnaces, condensers, and retorts, is a very important predisposing cause of the poisoning. Uncleanliness of the workmen appears to be no small factor in the production of the condition. Men who do not wash their hands well before eating or putting anything into the mouth, who do not care for their teeth, and who fail to rinse the mouth well before eating and drinking, those who do not take a hot cleansing bath at the end of each day's work and who do not change their work clothing for street clothing after work, develop mercury poisoning more often than those taking these precautions. Information regarding measures recommended for the prevention of mercurial poisoning and details regarding its treatment are given in Serial 2354, just issued by the Bureau of Mines.

Regulating Road Traffic

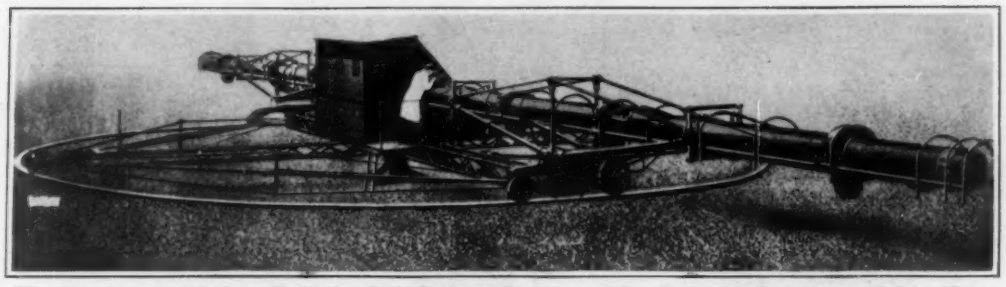
REGULATION of the character and weight of highway traffic to prevent undue injury to the highway is an administrative matter and cannot be properly taken care of by detailed and arbitrary legislation. This is the conclusion of the Bureau of Public Roads of the United States Department of Agriculture, based on experiments to determine the effect of all kinds of traffic on road surfaces and observations on conditions throughout the United States.

Even in a single State conditions vary to such an extent that a load which may be carried on one road without injury may cause untold damage to another. Under the average regulatory law thus far made effective, the greatest service has not been secured from the best roads, nor the safety of the lesser-capacity roadways assured. The influence of sub-grade soils, tire equipment, distribution of load to the wheels, speed, and many other variables is too complex to be written into law.

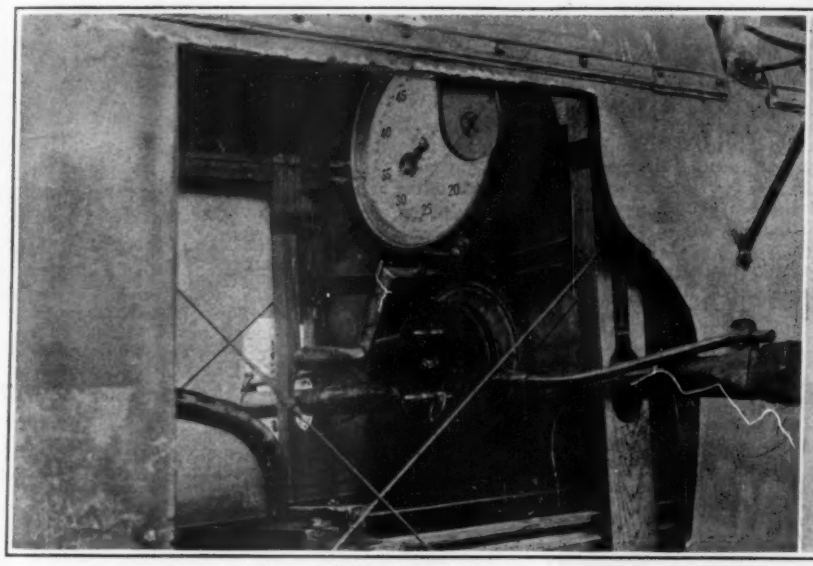
The seasonable variation alone in the carrying capacity of the roadbeds, due to moisture conditions, is one of the most serious of all the causes of road damage. Highway authorities therefore must be given wide discretion. The bureau urges that all State highway officials be given broad powers, so that traffic can be regulated to suit conditions as they exist at any particular time.

A Huge Coast-Defense Range-Finder

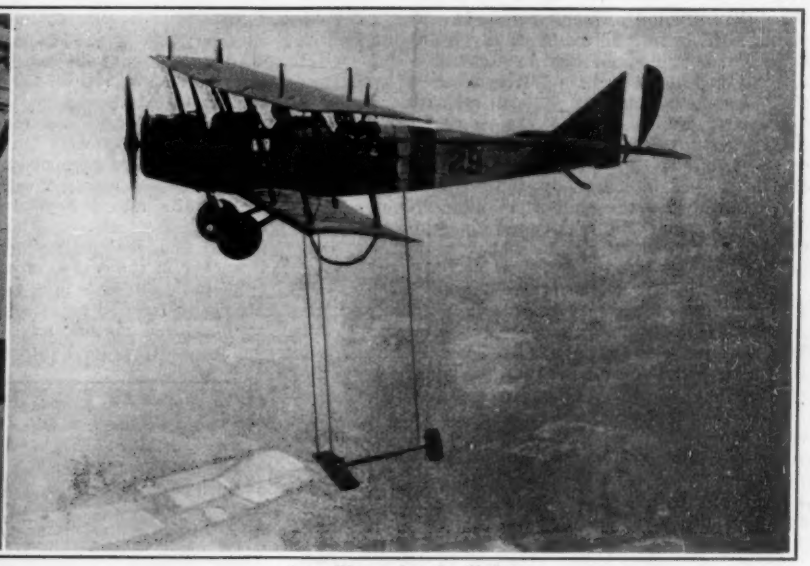
IF any of our readers know of a range-finder larger than the Brobdingnagian instrument herewith pictured, we shall be glad to hear of it. The picture of this particular finder has been sent us by a correspondent who tells us that it is to be used in the British coast defenses; that it is one hundred feet in length; and that it gives the range with accuracy up to a distance of 22 miles. A range-finder is an instrument for automatically and rapidly solving a triangle, the base of which is the distance between two lenses, placed one at each end of the telescope, the two angles being those subtended between the telescope and the object. The first range-finder, as used on warships, was a relatively small affair, the tube being only eight or nine feet in length. With this instrument it was possible to get a fairly approximate reading of the range up to nine or ten thousand yards. Then came naval range-finders with lengths of eighteen to twenty feet, and today our battleships carry at the back of their turrets range-finders that are over thirty feet in length. The advantage of increased length in the range-finder is due to the fact that the longer the base the larger are the angles subtended between the tube and the distant object, and the greater the accuracy of the reading. It would be impossible to install a one-hundred-foot range-finder, such as this, on board ship, but on coast-fortifications, with a concrete and perfectly steady and unchangeable base, there is no reason why they could not be built in such sizes, provided, of course, that care is taken to protect the tube against bending, twisting, or any other form of distortion. In this case the tube is supported at three points, namely, in the center, and midway between the center and the ends. It is stiffened against sagging by means of pairs of trusses, which will be noticed above the walls of the turntable. The tube proper, of course, has to be protected against the distorting effects of the sun's rays, and this we presume is done by means of an outer envelope and free ventilation of the air around the inner tube.



The largest range-finder. Built for British Coast-Defense work. It is 100 feet long and is said to give accurate readings up to a range of 22 miles



View of the balance assembly



A trailing wing in flight

Taking the Error Out of Airplane Wings

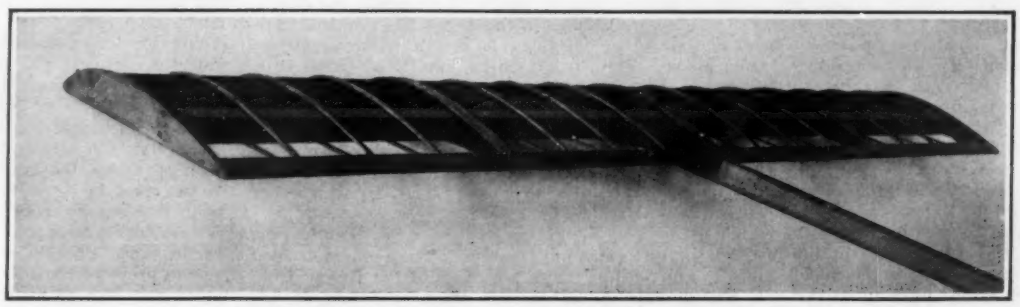
By George H. Dacy

ALMOST novel and satisfactory method of testing airplane wings has just been devised and perfected by the National Advisory Committee on Aeronautics—a group of twelve leading American scientists who work without pay and devote a large part of their time to the solution of aeronautical riddles. The new plan of testing wings consists in carrying full-sized wings, in turn, below an airplane during an actual flight. Special recording devices are used to register the stresses, strains and reactions which are developed in the wings as they are subjected to extremities of altitude and severe wind pressure and frictional resistance. Previously, the matter of testing airplane wings has included considerable scientific guesswork. Small models of the wings were tested in wind tunnels or on whirling arms and errors usually resulted on account of the small models which had to be used.

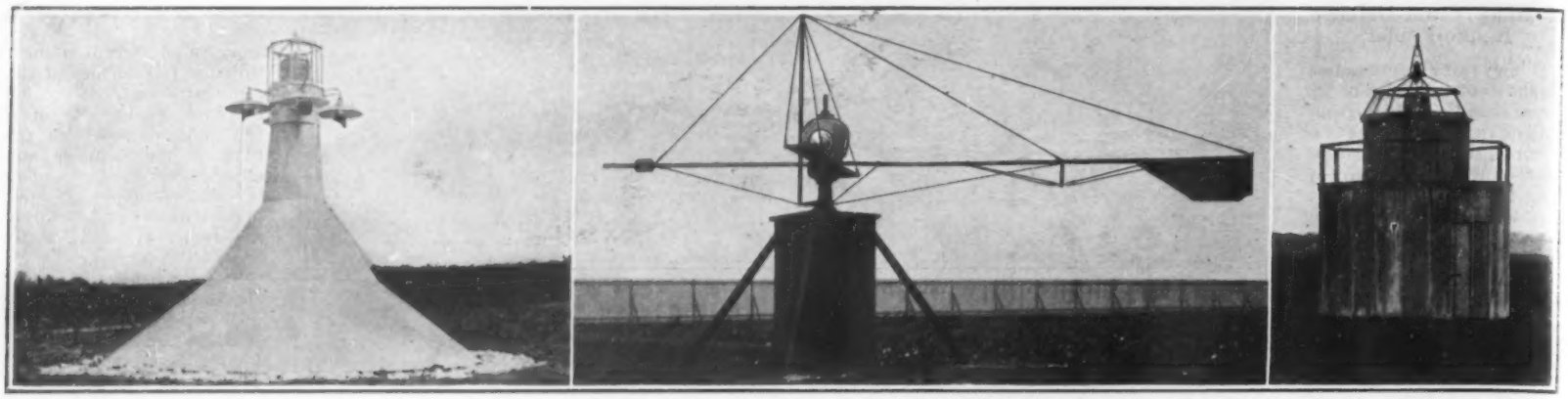
The new and improved method consists in suspending the wing to be tested upside down below an airplane in flight. It is supported by three steel wires at such distance as to eliminafe all opportunity for interference from the airplane or from the "wash" of its propeller. The model wing is inverted in order that the ordinary lift be converted into a downward pull. This keeps the test wing away from the airplane that is towing it. The amount of pull developed in this manner is exactly equivalent to the lift that would be developed if the wing were right side up. When the test wing is suspended in this way, the lifting force produced can be measured directly on spring balances through the suspending wires and its resistance from the angle of these wires to the vertical.

It was also necessary to devise some mechanical appliance for lowering or lifting the wing during the occasions when the airplane would take off or make a landing. It was necessary to take off with the test wing hauled up close to the body of the aircraft. Considerable difficulty was experienced in perfecting a mechanism which would do this work efficiently. In trying out various contrivances several accidents occurred. On two occasions, during flights, the model broke loose. Once it collided with the tail surface of the plane with such violence as to cause considerable damage and to jeopardize the lives of the engineer and pilot. However, after a number of alterations were made in the lowering and elevating apparatus, it was finally made letter-perfect.

The new scheme of testing full-sized wings was originated by Mr. F. H. Norton, in charge of aeronautical research at Langley Field, Virginia. The pioneer methods of testing airplane wings were developed by Dr. S. P. Langley and the Wright Brothers. The former used a whirling arm which carried a small model of a wing at its extremity while the Wright Brothers used the wind tunnel. Later on, a scheme was practiced of carrying a larger model of a test wing above a motor vehicle or railroad car while it was in motion. In the case of this latter expedient, the interference of the ground and the wind caused unavoidable inaccuracies. Furthermore, none of these methods duplicated the actual conditions to which the wings were exposed when under flight and hence they were not satisfactory. The new method recently devised remedies all these weaknesses and eliminates sources of error. It promises to standardize airplane wing testing and to curtail aerial accidents which might occur potentially as a result of inferior or inefficient wings. Henceforward, weak wings will be located and eliminated during the test trials. The aeronautical experts report that for the best results the new method of testing requires calm air conditions while the flight path must be in a straight line. For the purpose of demonstrating the possibilities of the method, however, several test flights have been made on days when the air conditions were unsatisfactory and turns were made with the wing suspended. It is possible to vary the angle of the model wing to the wind by raising or lowering the rearward suspending wire whereupon the angle is read by the aid of a telescope from a small inclinometer, or spirit level attached to the model. As the test wing is carried from 20 to 30 feet below the airplane, it is necessary to reel in the suspending wires until the model is close up to the body of the craft before a landing is attempted. By experiment, it has been determined that where the plane glides onto the landing field at customary speeds, forces are developed by the model which are almost capable of tearing it loose. This difficulty has been remedied by approaching the ground at lower speeds. It is anticipated that the new method of testing will provide designers with absolutely accurate wing-performance data.



The construction of a wing model built for testing



Left: Daytime appearance of the pilotage light shown, illuminated by night, below. *Center:* A lighting apparatus that has been tried out at Croydon. Its three "eyes" throw the light down the wings" and "tail" of the device in three directions. Swinging with the wind, its 27,000-candle flashes are visible for twelve miles. *Right:* An early form of aerial lighthouse at Hounslow

Lighting devices for the aviator's guidance that have been tried out in England

Lights as Aid to Aerial Navigation

Some Interesting Details of British Practice and British Design

By a London Correspondent

MUCH interest has been taken in the recently arranged night-service for aerial transport between Great Britain and adjacent countries. The great advantages of being able to fly safely by night, as well as by day, were emphasized by General Sir Frederick Sykes, Controller General of Civic Aviation, when presiding at a recent meeting of the Illuminating Engineering Society in London. It was pointed out that the great advantage of aerial transport is the high speed attainable; but this advantage is greatly minimized especially on relatively short routes, if machines have to lie idle during the night time. Speed, moreover, is of little use without regularity. The great problem, therefore, is to devise methods of using artificial light to render flying as safe by night as by day.

Some of the problems involved were discussed by Lt.-Col. L. F. Blandy (who is also associated with the Air Ministry) in his introductory paper before the Illuminating Engineering Society. There are firstly the lights carried by aircraft. Internally they serve to illuminate the quarters of the crew and passengers, and it was remarked in the discussion that the provision of ample illumination is a great aid to promoting a feeling of security on the part of passengers. The present practice is to use 12-volt incandescent electric lamps, supplied by generators driven from the engines and supplemented by storage batteries. Externally lights are provided to serve the same purpose as the port and starboard lamps attached to marine vessels. At the recent International Convention rules for such lights were drawn up. Thus it was recommended that aircraft should carry a forward white light with a range of not less than 8 kilometers, on the right side a green light of at least 5 kilometers range, on the left side a red light of similar range. These lights must be so mounted that the green light is not visible from the left side nor the red light from the right side. A rear white light is also specified and the dihedral angle through which all lights must be visible is indicated.

There seems some reason to believe that the above ranges are hardly adequate. It is calculated that in the case of two machines approaching, each at a speed of 100 miles per hour (*i.e.* with a relative speed of 200 miles per hour), the time from the moment of sighting the opposing headlight to the moment of collision would be only 90 seconds.

Another useful form of light carried by aircraft is that used for landing. Chemical flares may be attached to the wing tip and ignited electrically, yielding about 6000 candle power and lasting about two minutes. Parachute flares dropped through a tube and electrically ignited serve a similar purpose. At a height of 1000-1500 feet, they will light up roughly 150 acres, being of 50,000 candle power. More recently experiments have been made with electric incandescent lamps, mounted in suitable lanterns, for the same purpose. Such lamps, which may attain 1000-2000 candle power, have some obvious advantages. They are completely under the control of the pilot, can be used continuously while landing if desired, and the risk of fire in the event of a crash is less than in the case of chemical flares. On the other hand such lamps have to be run off the 12-volt supply that is alone available on the aircraft circuit, and therefore consume a large current and need very careful design.

Airdrome lighting comprises several distinct problems including (1) obstruction lights, (2) illumination of the actual ground and (3) fixed illuminated signs to show the direction of the wind, etc. Wireless masts, on account of their great height are particularly dangerous obstructions and require very careful lighting. At Croydon 1000-watt gas-filled electric lamps are placed on top of each mast, with smaller lamps down each leg of the mast. The lamps are screened red and incidentally afford a good means of recognizing the airdrome from above. The lighting up of the actual ground is a difficult problem and General Sir Sefton Braucker in the course of the discussion expressed the opinion that it was best avoided. To flood an entire area with light so as to assist the pilot in alighting is an expensive matter, and there is great difficulty in finding positions for lights such that they do not dazzle

The accepted pilotage light as it appears when illuminated for use at night

his eyes, thus constituting actual danger. An important principle, however, has been the outlining of the areas for departure and alighting by means of lamps arranged in the form of "L's." Here again the design of the reflectors used with the lamps has required care in order that the lights may be seen at different angles from above. The use of searchlights is attended with difficulties in regard to the formation of shadows when the pilot comes into the beam. A narrow beam, enabling the pilot to come down above it, seems to answer best, and at Croydon several searchlights are used for illuminating the ground and other purposes. These three projectors are placed roughly at the angles of an equilateral triangle.

We come next to the question of aerial lighthouses, which serve to mark out the route. They can be divided into (*a*) navigating lights, which guide the aviator from a considerable distance away when traveling on his aerial route, and (*b*) local pilotage lights which guide him into port when he approaches his destination. The problem is quite different from that met with in designing marine lighthouses, for the reason that the light must be visible at many different angles. It is also more difficult for an airplane moving at anything up to 200 miles per hour to locate a light, than for the relatively slow-moving ship to do so. Experience has shown the necessity for an absolutely homogeneous light throughout the whole 180 degrees. The distribution of light, taking into account atmospheric absorption and all other factors, has demanded much calculation. Aerial lighthouses of an automatic type using dissolved acetylene have been in favor and one type has been in operation, first at Hounslow and then at Croydon, since the end of 1919. Similar lights are being installed at other stations. They are visible for a distance of 35 miles and can be equipped to continue working without attention for twelve months.

These lights are of the revolving type, the rotation of the lens being effected by the movement of sensitive diaphragms operated by the gas passing under pressure to the burner. The light is controlled by a sun-valve so that it is automatically extinguished in full daylight and relighted at dusk. The sun-valve depends for its action on the unequal expansion of two rods, one coated with a dead black material, the other highly polished. It is interesting to note that during the recent solar eclipse the lights duly came into operation.

For local pilotage lights a distinctive *shape* was found very useful as a means of identification. As will be seen from the illustration the lighting unit (consisting of a 1500-watt gas-filled electric lamp) is superimposed on a truncated cone, the base of which is 24 feet in diameter. The cone is painted a light color and being brightly illuminated is visible as a triangular patch of light at a distance of 15 miles. The lamp is also enclosed by a 36-inch parabolic lens, forming a brighter upper unit which can be seen 25 miles away. In addition great assistance is derived from certain marine lights. Thus the Nore Light Vessel has been observed at a distance of 30 miles by an observer 1000 feet up while the very high-powered light at Cape Gris Nez has been observed as far away as 68 miles.

Oxyacetylene Welding and Cutting Blow Pipes

AN interesting investigation conducted by the Bureau of Standards at the request of the War Department consisted of tests of the relative merits of all the standard makes of oxyacetylene welding and cutting blow pipes. The tests were conducted in such a way as to eliminate almost entirely the personal equation and to indicate correctly the relative merits of the different kinds of apparatus.

Technologic Paper No. 200 of the Bureau of Standards, which has just been issued on this subject, is for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 35 cents per copy. It describes in detail the apparatus used to make the tests, the character of the tests themselves, and gives certain conclusions concerning means for improving the performance of this class of apparatus. The paper should prove of considerable assistance to users of blow pipes and also to manufacturers, as it indicates lines along which improvements ought to be carried out.

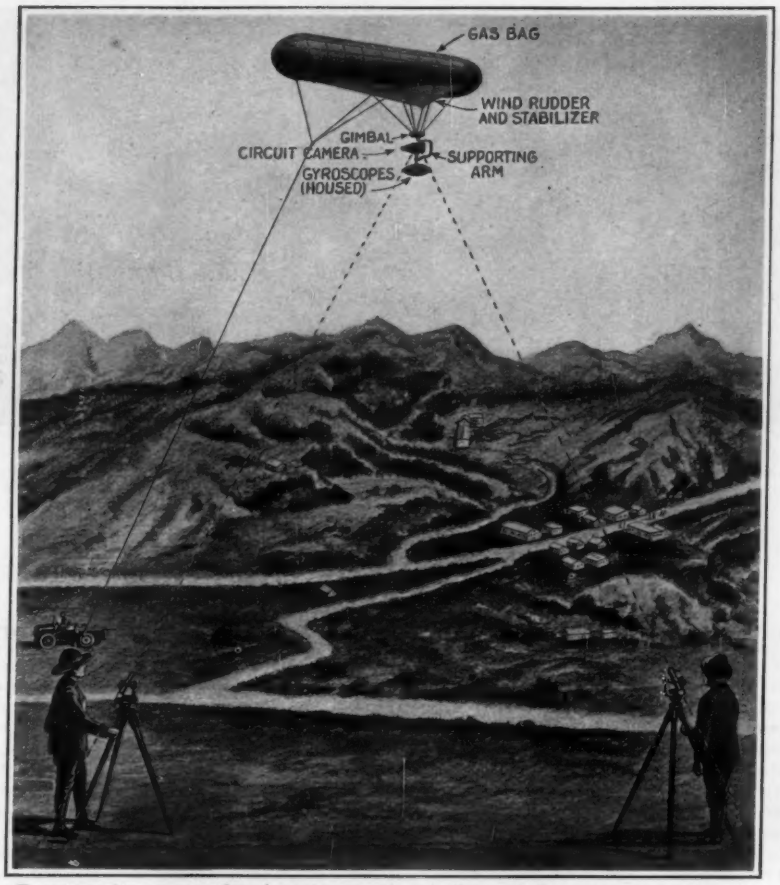
Taking Aeronautical Photographs From the Ground

By John Edwin Hogg

THE ever increasing demand for and the manifold uses of aeronautical photographs, has in recent months set innumerable inventive minds to working upon the problem of how such pictures may be produced efficiently and at small expense. The value of such pictures taken from aircraft has long been established for a multiplicity of purposes, but it has remained for Mr. F. M. Huddleston, of Los Angeles, California, to develop the means of taking such photographs without the necessity of the photographer's risking his life in the air. Furthermore, the elimination of the flying photographer from the science of aeronautical picture-taking knocks the cost of aeronautical photographs into the proverbial cocked hat, and makes possible the production of many photographs utterly unattainable when the photographer attempts to work under the present physical limitations of man-carrying aircraft.

By the use of a triple gyroscopic balanced camera operated by electricity and carried to any desired elevation by a small pilot balloon, the modern aeronautical photographer is enabled to produce aerial pictures without ever taking his feet off the stable supporting medium of "Old Mother Earth." It makes little difference to him if the scene to be photographed is surrounded by high-tension electric lines, trees, mountains, or other ground obstructions, known to airmen as "the graveyards of aircraft," for he risks nothing in the air but a camera and a few dollars' worth of manufactured equipment. He can produce any kind of aeronautical picture desired, from a length of motion picture film to a panoramic view, a bird's-eye snap-shot, or a series of vertical photographs to be composited into a mosaic pictorial map. And, he can do all this at a reduced cost which virtually drives the flying photographer out of the field of competition with him.

The aerograph, as the electrically controlled camera-carrying balloon is called by its inventor, is the result of several years of painstaking experimentation and development. It embodies 42 ideas which have been covered by basic patents. Its operation is further made possible and practicable by the combining of a number of mechanical practices which but a few years ago were hailed as individual discoveries in the field of science. Chief among these features is the use of the triple gyroscope for holding the camera in an absolutely motionless position while the photographic exposure is being made. The camera is mounted upon an adjustable tilting-head base, which in turn is hung in an off-set metal support swinging in gimbals from the balloon. A storage battery which supplies the electric current for the operation of the entire mechanism is mounted above the gimbals, and serves as a counter-balancing weight against the weight of the camera, gyroscopes, and supporting members. Bulk for bulk the storage battery is proportionately heavier than the camera, supports, and gyroscope mechanisms, so that the whole arrangement is delicately balanced in the gimbals. The gyroscopes, three in number, are housed within a metal structure at the base of the assembly. From the gyroscopes electric wires go down the cable which holds the balloon captive, and by means of these the operator on the ground controls the balance and adjustment of the entire device. The action of the gyroscopes for holding the camera stationary, or tilting it in any desired direction may be compared to the three legs of a tripod such as is used by photographers on the ground.



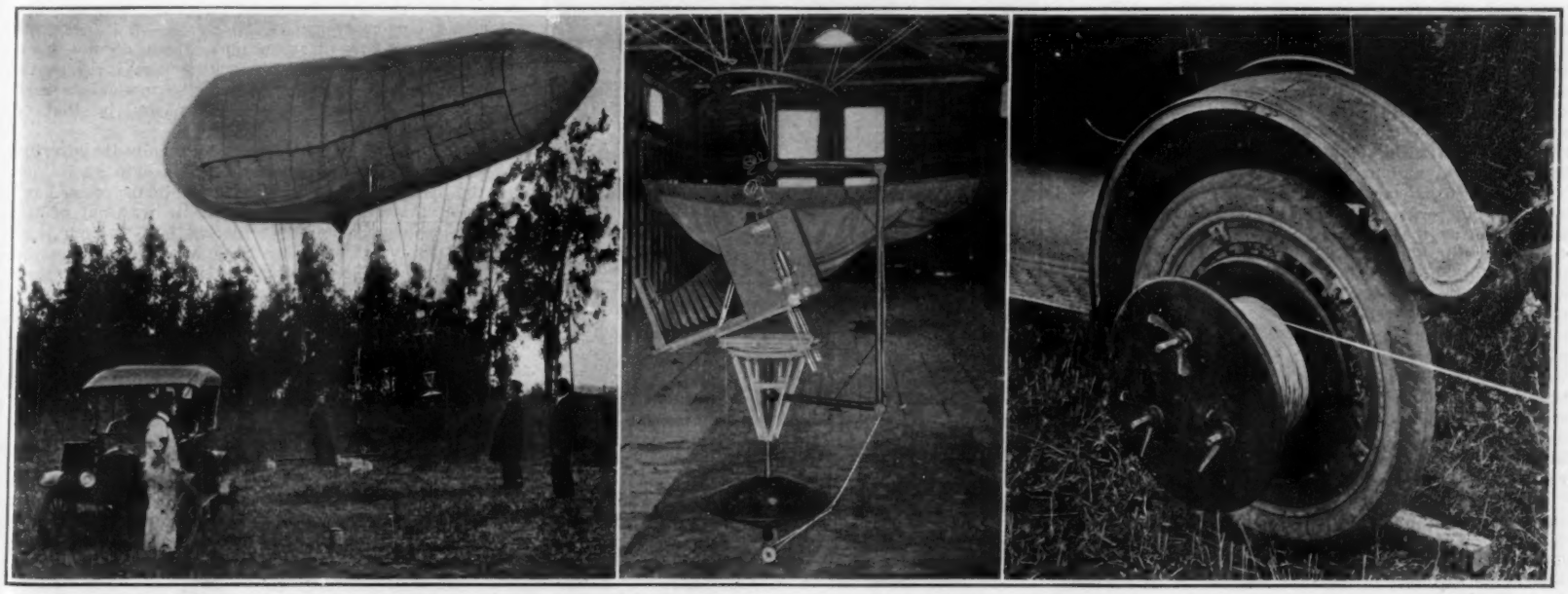
Two transit men on the ground, a captive balloon aloft—and six months of ordinary surveying is done in ten seconds

When the ground photographer desires to change the position of his camera he adjusts the legs of the tripod to bring the camera into the proper position. Thus it is with the aerograph camera hanging in its gimbal mountings from the captive balloon. The three gyroscopes correspond to the legs of the tripod. If the electric current which keeps them turning is supplied with equal strength to all three gyroscopes at the same time the camera with its gimbal mountings is held in a stationary position. The bed of the camera is then held horizontally to the four points of the compass. With this arrangement it is obvious that if one gyroscope is caused to operate at higher speed than the others the camera will swing in its gimbal supports in that direction, and may be held in any desired position as long as the speed of the gyroscopes remains constant. Thus, by speeding up, or slowing down any one or two of the gyroscopes the camera may be tilted, and held in a stationary position for focusing it properly upon the scene to be photographed.

In addition to the electric gyroscope controls for moving the camera at the will of the operator on the ground, the camera is fitted with a magnetic shutter, and an electro-magnetic device for tuning up the film in the instrument after each exposure is made. A control and indicator board before the operator on the ground enables him not only to move the camera and operate it, but shows him at all times how many degrees of tilt he has given the instrument in any direction. With this information, and a simple method of mathematical triangulation, he is able to figure exactly the scope of territory that will be included in the photograph. With certain known bases and angles to form the basis of mathematical calculations no great amount of imagination is needed to visualize the innumerable applications of this method of captive balloon photography for securing quick information at a low cost to be used in the various fields of engineering.

It was only in recent months that the first successful photographs were taken from the air by means of the electrically controlled camera-carrying captive balloon. These tests exceeded even the fondest expectations of the inventor in the quality of aerial photographs that were produced. These results may be attributed to the fact that by this method aeronautical photographs are taken almost identically as if the camera were being operated on the ground. Time-exposure pictures from the air may be taken as easily as snap-shots, which is something utterly impossible when photographing from a moving aircraft. In photographing from a moving aircraft a short quick exposure is essential to overcome

(Continued on page 216)



Left: The aerograph being pulled down after taking a dozen photographs at 3000 feet. *Center:* The mounting by which the aerial camera is hung from the captive balloon. Manipulation of the camera and, in fact, of the entire apparatus, is electrically controlled from the ground. *Right:* During the experimental work the hoisting drum was mounted on the wheel of a jacked-up car

Closer views of some of the apparatus employed in taking aerial surveys from the ground

Left: These insects, known as silverfish, have existed from remote times, and show practically no change from the fossils of their ancestors found in ancient rocks. *Center:* Oniscoiden, or sow bugs, primitive animals which are related to the crayfishes. *Right:* Limulus, the horseshoe crab, a marine animal of great antiquity. It is more of a spider than a crab. Its life history is curious in that its larva shows unmistakable affinity with the extinct trilobites. This creature is shown approximately in life size; the two others are magnified four or five diameters

Three examples of animals of today that date back to remote geological times

Down Through the Ages

Intimate Glimpses of Animals Which Have Survived from Prehistoric Times

By William Crowder

OF the countless tribes of creatures which once tenanted this earth, it may safely be assumed that only a small fraction has left any record of its existence in the form of fossils. The fossils we do find, however, are, by reason of their variety, structure, situation and other contributory features, impressive testimony of the enormous host which once existed, but which has long vanished and left no trace whatever. What caused the extinction of those remote types can now, of course, be determined only within a reasonable degree of probability, but it is plain that in an absolute sense this must always remain more or less a mystery; for although the story as we read it in the organic petrifactions imbedded in the rocks is in the main authentic, it seems in certain instances to be a contradictory one. Here we find it seemingly revealed how impossible it was for certain forms to have persisted throughout the changing conditions in the earth's history to times like the present—times so utterly unlike that far-off era of torrid days and steaming nights—and we accept these revelations as convincing clues to the cause of their disappearance, until the strange truth is discovered that in several notable instances these ancient fossils are represented today by living forms which are practically unchanged from their distant ancestors. Now, therefore, if the total annihilation of the majority of those prehistoric legions is cause for wonder, it is no less strange that certain of them have survived the vicissitudes which overwhelmed their earlier contemporaries. But, in this case, also, the real reason of their survival will perhaps never be known.

Among the animals which have thus survived, few are more familiar than the silverfish and the sow bug; the former being that little glistening gray elusive household insect with three tails, found secreted in dark nooks, while the latter is known everywhere by its habit of frequenting damp situations such as under decaying wood and in cellars.

The silverfish, sometimes called the bristletail, belongs to that order of wingless insects known to entomologists as the Aptera. This order comprises two suborders: the Thysanura, which includes the bristletails, and the Collembola, represented by the springtails. Despite their absence of wings the Aptera are the most widely distributed of all creatures; they have been found in almost every terrestrial region of the globe, even at frozen mountain tops and in the caverns under the earth; but, curiously, the silverfish itself and some closely related species are never found away from human habitations. This great range of the Aptera is, of course, significant of but one thing. They have acquired their distribution long before the present continents were separated by the modern oceans.

Unlike the springtails, whose mouthparts are obscure, the silverfish is provided with prominent cutting jaws, to the efficiency of which many housewives can testify. They are fond of starchy substances, and their preference for this sort of diet has resulted in an appreciable amount of damage. They have been known to attack the paste behind wallpaper, causing the latter completely to separate from the wall; silk goods which have been stiffened by sizing are also within their dietary; but the greatest harm they cause is to books—they will eat the bindings and gnaw off the labels and lettering to get at the paste underneath.

However, it is the structure of this creature that has always interested naturalists rather than its habits. The segments of the body are quite distinctly marked. The three which constitute the thorax carry the walking legs; but attached to the underside of the eighth and ninth abdominal segments are small false legs, not

Fossil crinoid, or sea lily (Forbseocrinus Meeki), a precursor of the star-fish that has, now living, descendants of practically unaltered form

unlike those of caterpillars. In fact the silverfish, together with its close relatives, resembles the caterpillars not only in this but in many other features. It is evident that in its evolution it has halted in the caterpillar stage and for that reason has never developed wings. It is in this stage that it hatches from the egg, never further completing a metamorphosis even of the most modified kind. From these facts it was once supposed that the silverfish and its near allies represented the primitive type from which all other insects have descended—a supposition, however, which is no longer entertained.

In point of time of origin, the sow bug doubtless antedated, by far, the Aptera. Its place in the animal kingdom is also much lower; for, regardless of the several popular names by which it is known—namely, pill bug, woodlouse, etc.—it is not an insect, it is an isopod crustacean. That is to say it is a relative of the shrimp and the crab. In the more exact language of science, however, it is a member of the Oniscoidea, a numerous family which is unique among crustaceans as being the only instance wherein the individuals spend their entire lives out of the water. Nevertheless, it is quite certain that in some former period of their development they were inhabitants of the sea. This migration from the sea to the land was, of course, accompanied by a change in their method of breathing; yet the change was not complete enough to enable them to exist in a perfectly dry atmosphere. And that is why they are always found in moist locations.

Under natural conditions the chief food of the sow bug seems to be decaying wood; but it is, in fact, practically omnivorous, eating almost any food that comes its way. In the writer's feeding experiments upon this animal he has found that it shows a decided preference for rolled oats and prepared breakfast foods! Notwithstanding the popular belief that it is a lover of carrion, it will not touch food which has any taint of putrefaction, regardless of the call of hunger; it will allow itself to starve to death before availing itself of this sort of repast. Being a nocturnal prowler it is during its nightly excursions that the sow bug searches for tid-bits and other variations from its staple diet of rotten wood—that is, whatever varieties its immediate vicinity offers, for it never wanders far from its customary retreats. Despite the fact that this creature lives in situations which do not meet human requirements for immaculateness, it keeps its body scrupulously clean. Indeed, the meticulous care with which it grooms itself is surpassed by that of few other animals.

The manner in which the sow bug molts its covering is singular. Instead of shedding its skin entire, as is the usual habit among other animals of a hard exterior, this creature first works its way out of the portion which invests the hinder half of its body, and then after a rest of a day or so withdraws from the remainder. No sooner has the molt been cast than it is set upon by other sow bugs which may be near, and who devour it not for its nutritive value but for the material it contains for forming their crusty coats. Sometimes sow bugs do not stop at this mild form of cannibalism, but on occasion an individual will be seen to jump on another, securing a firm hold and leisurely eat off the antennae of its squirming victim. Beyond this mutilation, however, the writer has seen no further damage inflicted.

Now a rather peculiar circumstance arises in connection with the animals we have been considering. Certain of the Thysanura and a majority of the Oniscoidea are never found elsewhere than in the immediate neighborhood of human habitations. Moreover, as their association with man seems to have been of long standing they may aptly be termed domesticated. Yet, how it has come about that the silverfish and sow bug have been able so completely to adapt them-

selves to their newer environment without undergoing the slightest modification in structure, is one of the unexplained puzzles of nature. Certain it is, however, that, unless they revert to their primitive habit of living in the open, their days are numbered. Man's advance in civilization has increased his intolerance of these age-old companions, and as a consequence his habitations continue to be constructed in a manner which makes it more and more difficult for these creatures to maintain themselves.

Still, old as these animals are, there is good reason to believe that they are mere infants, so to speak, when compared with many types which are found in the sea. It was unquestionably in the sea that life on this planet first appeared. For millions of years before conditions on land made organic development here possible, the sea teemed with strange and varied types, many of which are long extinct, but not a few of which thrive today.

Even in the waters of the sea the greatest changes in type forms took place among those animals which lived at or near the surface and along the ancient shores; and those changes can be traced to a very probable cause. These regions were subject to great variations of temperature (an indirect factor, admittedly, but an extremely powerful one). There was one region, however, in which life tended to remain more or less constant. This was in the deeper parts of the ocean, where the temperature never varied. In those cold abysmal depths there still thrive today, just as in the hoary past, the crinoids, or sea-lilies, plant-like animals rooted in the ooze, rearing their ghostly stalks in the icy darkness, awaiting eternally their unseeing prey; and throughout those unlighted deadly fields of white there glides and crawls a weird host of an antiquity not far removed from that of the crinoids.

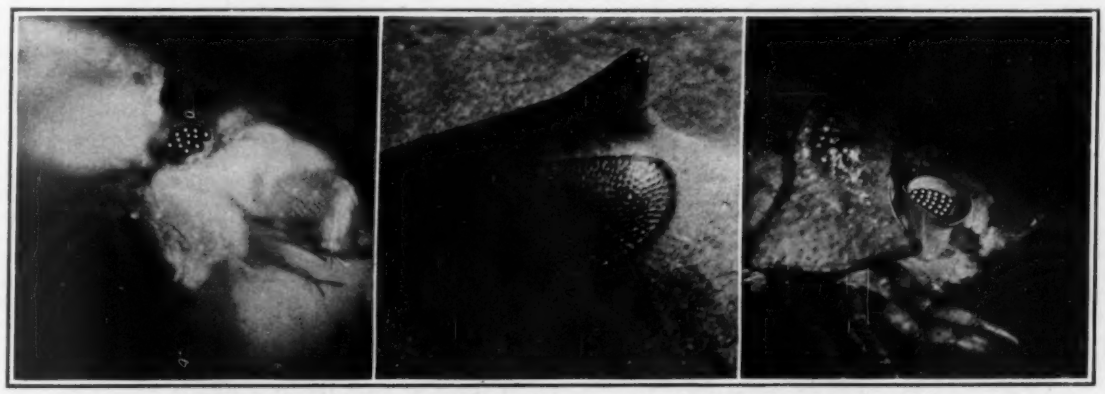
It is, however, quite unnecessary to search the deep sea for survivors of prehistoric times; one of the commonest creatures of our shore waters is an animal so old that its very identity is a subject of doubt. This is Limulus, the horseshoe crab. Whether Limulus is allied to the spiders, which seems evident, or whether it belongs with the crabs, which certain evidence also seems to support, need not concern us here; it is, nevertheless, interesting to note its unmistakable affinity with the trilobite, an extinct animal whose remains occur in some of the oldest fossiliferous rocks to be found anywhere on the globe.

The trilobite was a three-lobed, segmented organism which inhabited the early seas in enormous numbers. In general appearance it was somewhat similar to an isopod crustacean. It lived by plowing its way through the mud and sand after worms and other soft-bodied creatures, very much as Limulus does today. Like Limulus its exact position among animals is still undetermined; but here arises a peculiar circumstance. The larva of this animal was in every essential respect identical with that of Limulus. For that matter certain species of trilobites did not differ in their adult stage from the present young of the horseshoe crab. It will be seen, therefore, that the trilobite-like larva of Limulus identifies itself at once as the most ancient type of all articulated animals.

Like the silverfish and the sow bug, the horseshoe crab is fast disappearing. In recent years mankind has become more generally aware of the edible properties of this animal and of its great value as a soil fertilizer. This has resulted in a wholesale and unintelligent slaughter. Naturalists have recorded that as recently as the year 1856 more than a million of these creatures could be seen to come ashore and lay their eggs within a single mile along certain sections of the Atlantic coast. That this abundance nowhere near exists today is ample testimony that they are approaching an early extinction. From present indications, therefore, it is safe to say that the next few centuries will have witnessed the passing of the forms here reviewed. But their fossils will still continue to be found. And it is an amusing, if curious, reflection that perhaps their discovery by future savants may cause our present civilization to be identified by them in terms such as "contemporaneous with the silverfish, the sow bug, and the horseshoe crab," much in the same way as we now refer to our rude ancestors and the primitive creatures with which the fossil remains show that they were contemporary.

The "trilobite" larva of the horseshoe crab, showing the unhatched embryo contained in the egg; about 12 diameters magnification

Fossil trilobite embedded in rock from millions of years ago. About natural size



Left: Eye of silverfish (x20). *Center:* Eye of horseshoe crab (x3). *Right:* Eye of sow bug (x10)

A group of views showing the primitive compound eye to be a mere group of simple facets that have not yet received their hexagonal shape through compression

Transparent Rubber

WHEN in the effort to find new uses for rubber, rubber chemists of international reputation turn their attention to producing such fantastic products as transparent rubber, in other words a rubber glass, they are apt to be accused of either too vivid an imagination or else loss of nerve, being ready to jump at anything to save the day. Still, it is so often the improbable and alleged impossible that happens that even the most startling announcements must be given due consideration, especially when they originate from such well-known conservative sources as the British rubber industry.

Rubber glass is a good thing to think about. What could be done with such a product defies imagination, however more expensive the product might be than the common glass. Rubber as transparent as glass, and still as elastic and non-breakable as ordinary rubber offers many advantages and products of rare and strange effects could be made from it. Details as to how transparent rubber is made from the opaque black native substance are not available, but it is said that so far the soft transparent rubber product can be made and that further research will surely lead to the fabrication of the hard variety.

Think of transparent rubber windows that you could push out with your hand and which would then spring back again into place. The small boy who throws his baseball against such a window will be astounded to have his ball returned to him on the rebound; the window will remain intact. There will be no longer any use for plate glass insurance, and the insurance companies would welcome the innovation with open arms. Seriously, unbreakable window panes, made from transparent rubber, would be a real boon in preventing the accidents that are caused by flying glass. Windshields and windows of such material in automobiles and cars, railway trains and street conveyances would make them considerably safer to travel in. How long such rubber windows would last under the action of the sunlight streaming through them is another question, but then this could undoubtedly be overcome.

When we put on our rubber shoes in overcast weather, expecting it to rain and are agreeably surprised when it does not, we still have the rubbers to take care of. Nobody likes to be seen wearing rubber shoes in clear weather. Transparent rubber shoes would be invisible. Various articles of personal wear and adornment, especially for the ladies, would offer considerable attraction made from transparent rubber. Bathing caps of this material would allow the color of the tresses underneath to be revealed. Toys of all sorts could be made from this material with peculiar and startling effects, such as balls so light that they appear as bubbles, dolls which you could look through. The novelty business would be able to use considerable quantities.

When it comes to scientific instruments, the possibilities of the utilization of transparent rubber are replete with great potentiality. Enormous objective pieces for telescopes could be made much more readily from the transparent rubber than from glass, and we might yet look right into the Martian homes and see the family eating their daily meals. Eyeglasses of rubber glass could fall off any number of times without smashing. The surgeon would find certain of his instruments of peculiar value when made of transparent rubber. All in all we have here a substance whose possible uses can only be guessed at now. Whether it can be made as claimed is another question. There need scarcely be any fear of the glass manufacturers having to close down their plants for a long time to come. We live in a world of constant and increasing progress, and sometimes when we learn of a new thing suddenly, we are startled at the quickness of this progress. Rubber glass is brand new; its further development may be rapid or it may go the way of many inventions of alleged wonder and astonishing innovation.

California's Test Highway

A Concrete Roadway Built to Be Destroyed in Tests of Its Durability

By Charles W. Geiger

CALIFORNIA has a road that is built only to be destroyed. Her highway engineers have laid down at Pittsburg (Cal.) a section of concrete test highway which is being tested to destruction by operating over it motor trucks of various sizes and weights. The purpose is to determine by observation under the same conditions of wear and on the same subgrade, the relative merits of different materials and cross-section design and at the same time to develop, if possible, an improved type of plain and reinforced concrete pavement.

General view of the concrete test highway built in the form of a race-track

The test road is an elliptically shaped roadway 1,370 feet long on the center line and 18 feet wide. It comprises 13 sections of concrete pavement differing in design as well as in the quality and location of reinforcing.

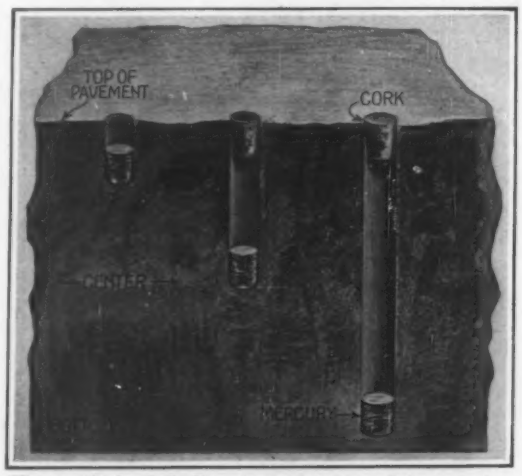
Before starting the building of this test highway, questionaires were sent to the highway engineers of the state, asking for their views as to what should be included in the test, or any other suggestions they might make. The state and federal engineers were also consulted with the same object in view. The hearty cooperation of all was freely given, with the result that thirteen types were selected as conforming most closely to all the views given. These include both plain and reinforced concrete in thickness varying from five to eight inches. It is constructed in the form of a race-track and is built entirely on adobe ground.

Tests were started recently. Engineers and state, county, city and Government officials from all over the State are watching the test. The conditions of the test are such and the participation of eminent engineers of such a nature that the results will be of the utmost value to road builders.

The tests will last for several months (or until the test highway is totally destroyed) and sections of the road that give way first will be repaired so that the whole road will be usable until its last unit fails under the strain. This will afford a valuable opportunity to observe the results of various types of repair work.

Forty motor trucks donated by the Federal Government are being used in the test. Observations are being made of the results of this traffic and later, when some of the stronger sections fail to yield, War Department equipment will be used to complete the destruction. This will include heavy tractors, gun carriages and the new government caterpillar tractor, which weighs 28 tons and has a speed of 25 miles an hour.

By means of four tunnels built under the concrete test highway, observations and tests are being made which up to the present time have never been possible. By means of these tunnels, the engineers are now conducting many kinds of observations from the under side of the pavement and are finding out just what happens to the under side of the slab and to the subgrade. These observations are made possible by means of rods which pass up through the roof of the tunnel and have their upper ends embedded in the concrete pavement. As the trucks are driven over the pavement, every movement of the pavement is transmitted through these rods (there being nine rods in each tunnel spaced two feet apart) to pens which traverse a recording sheet. This consists of a sheet of paper 11½ inches in width, which is wound on a drum, backgeared 4800 to 1 to give a velocity of from one to four inches per minute. The nine slab-rods operate the recording pen by means of adjustable extension to the rods giving a lever-rod ratio of 4 to 1; that is, the movement of the slab is multiplied four times, and this multiplication recorded at the pen. Each moving pen has a companion pen, which is called the mean-line pen. This



The method of finding temperatures of top, center and bottom of the concrete slab

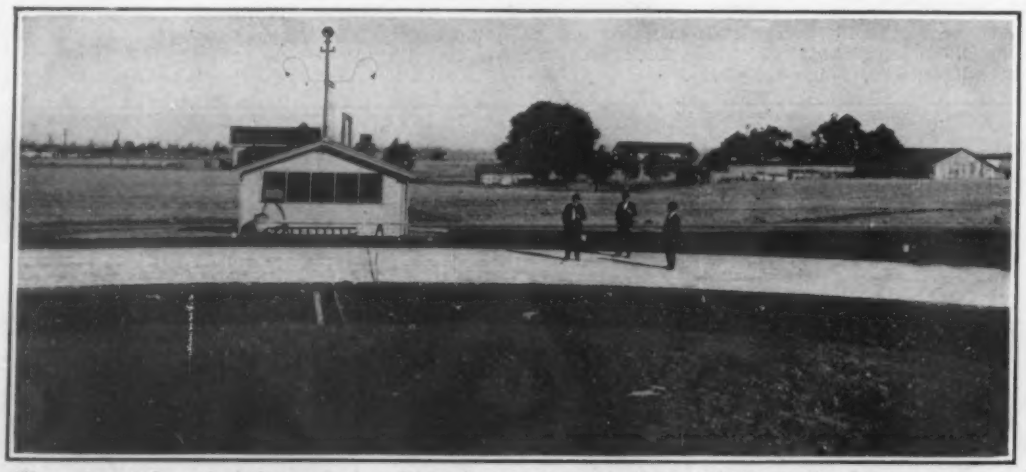
pen is stationary and inscribes the line from which the deflection measurements are made. This automatically compensates for any lateral shifting of the recording paper. Each pen is allotted a different section of record paper so that deflection lines will not conflict.

An independent set of rods is embedded in the subgrade, and is being used in studying the subgrade movements, instruments being attached to the lower end of these rods, but not of the same type as those described.

There are two ditches extending around the entire test highway, one on the inside and the other on the outside of the track. These are so arranged that water can be turned into the ditches and raised to the height of the top of the subgrade in the study of the moisture effects on the soil. By this means the subgrade will be alternately flooded and then dried out, and by means of the recording devices in the tunnels comparisons will be made on the supporting power of subgrade when dry and when wet. Holes in the concrete pavements have been provided so that borings can be made in the subgrade, to determine the moisture content of the subgrade.

A novel method was employed in obtaining the temperature of the top, center and bottom of the concrete slabs. In each of the thirteen sections of pavement there were drilled three holes, one reaching to a point near the bottom of the slab, the second reaching to a point near the center and the third extending only a short distance below the top of the slab. These holes were lined with plaster of paris, after which a quantity of mercury was placed in each hole, and the holes corked up at the top. When it is desired to take the temperature, the corks are removed and the bulb of the thermometer is inserted into the mercury (in the bottom of the hole) for a short time, and then removed and the temperature read. Otherwise it would have been necessary to install 69 thermometers in the concrete. By the use of the mercury in the holes, a more exact temperature can be obtained than if thermometers were installed in the concrete, as the mercury gives perfect contact with the concrete and imparts perfect contact to the bulb of the thermometer.

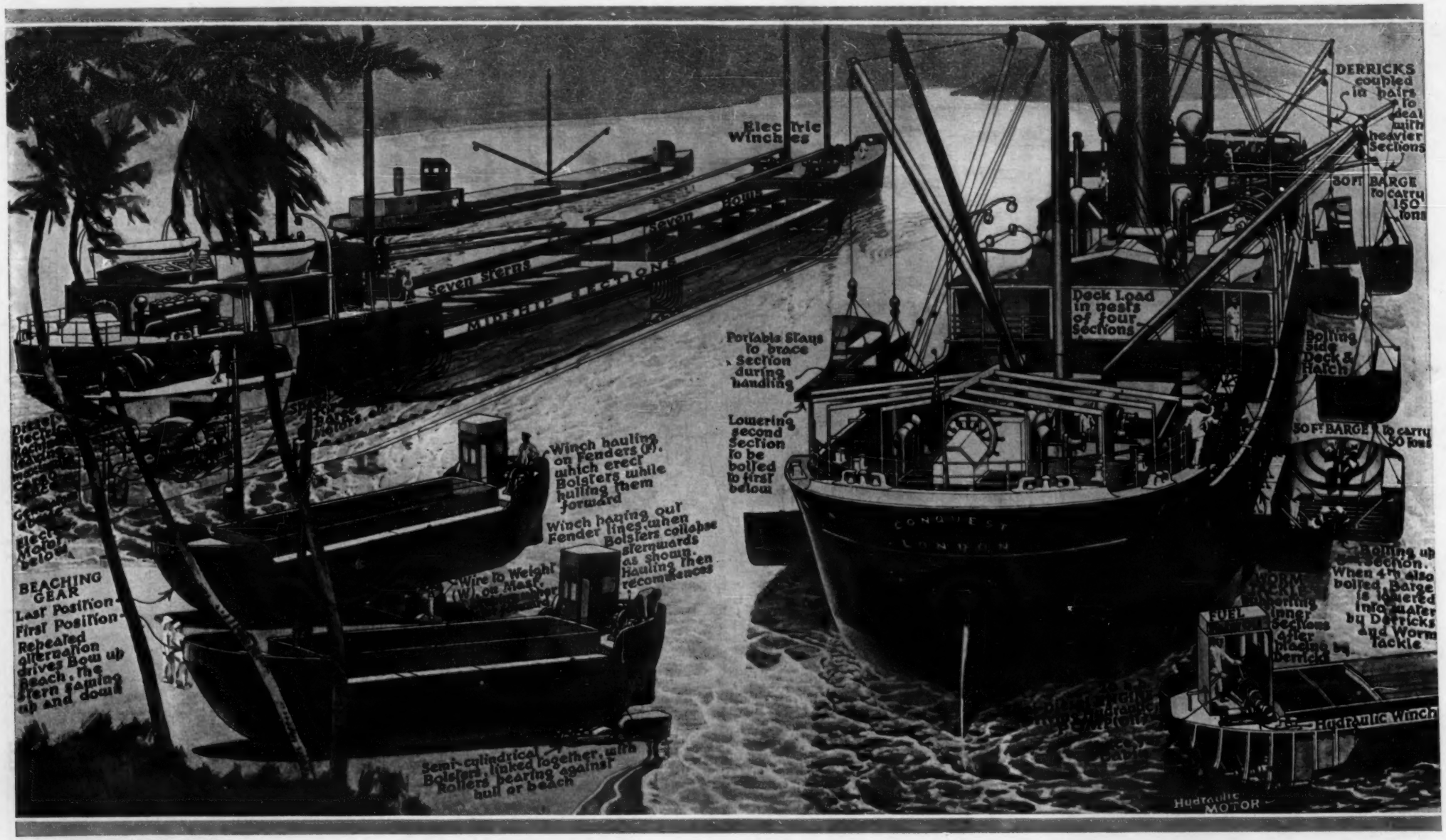
The appeal of the test highway to popular interest has attracted much attention. Cement, sand and gravel was contributed by interested firms, equipment for the construction of the test highway was loaned by manufacturers, and the contractor undertook the work for the bare total of force account and expenses, while all testing work is being done gratis by a firm of testing engineers. The motor trucks which are being used in the test were donated by the United States Government. The California State Highway Commission is supplying drivers for twenty of the trucks, and tire and oil concerns are arranging to donate tires and gasoline and oil. The test highway cost approximately $100,000, but it is expected that it will cost many times this amount to destroy it by motor truck traffic, and without all this aid the work could hardly be undertaken.



The curve at the end of the track; just discernible are the lines that mark the track off into squares so that the progress of cracks can be accurately followed. The big light floods the track at night, so that testing the roadway is a 24-hour proposition

Novel Flanged Engine-Bearing

AN engine bearing with large radiating flanges to help carry off the frictional heat has recently been placed on the market. The bearings are similar in shape to regular bearings, but are provided with radiating flanges at both ends which extend parallel with the crank arms. While the ordinary bearing is supported by the metal of the crankcase wall or its partitions, oil is likely to get into the joints and prevent the ready conduction of heat. It is claimed that as a result of the better heat radiating facilities the flange cooled bearing will last longer than an ordinary design, especially in high speed engines.


Electric Winches
DERRICKS coupled in pairs to deal with heavier Sections
30 FT BARGE to carry 150 tons
Deck Load in nests of four Sections
Portable Stays to brace Section during handling
Lowering second Section to be bolted to first below
Rolling side Deck & Hatch
30 FT BARGE to carry 50 tons
Winch hauling on Fenders (F), which erect Bolsters while hulling them forward
Winch hauling out Fender lines when Bolsters collapse sternwards as shown. Hauling then recommences
Wire to Weight
BEACHING GEAR
Last Position
First Position
Repeated alternation drives Bow up Beach, the Stern gaming up and down
Semi-cylindrical Bolsters, linked together, with Rollers bearing against hull or beach
Rolling up Section. When 4th also bolted, Barge is lowered into water by Derricks and Worm Tackle
Hydraulic Winch
Hydraulic MOTOR

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SHIPS WITHIN SHIPS: A NEW SYSTEM OF BARGE TRANSPORT

A NEW shipyard has been opened in England to build standard vessels for what is known as MacGregor's patented system of barge transport, the details of which provide literally a revelation of the possibilities of barges, particularly in opening up those great tracts of undeveloped lands which have no port facilities of any kind. A sheltered anchorage with 15 feet of water, such as the tropical bay pictured, is all that is required for the operations.

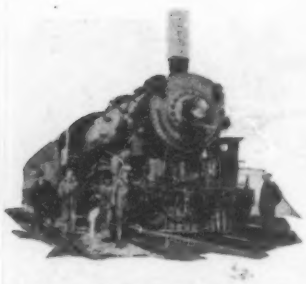
Barges are commonly sent abroad either in separate numbered plates and frames, requiring a shipway for erection, or in floatable sections, occupying very large and expensive cargo space, for jointing afloat, both of which methods necessitate skilled labor. Again, barges may be towed at a prohibitive price and at exorbitant rates of insurance, due to the great risks involved.

Now, however, eight barges, each of any standard size between 50 and 150 tons capacity, can be carried, as a deck load on any ordinary cargo steamer having quite ordinary three-ton derricks. As may be seen on the right, these barges have spoon-shaped ends, and are divided on their central longitudinal and transverse axes, to form four similar quarter sections, a complete set being nested one within another and stowed at each side of each of the steamer's hatchways.

Upon arrival at their destination, each section in turn is put over the side by a derrick. The first two, or midship sections, are each slung by two worm tackle blocks from the ship's deck, a few feet above the water, and the derricks let go. They are then bolted together at the midship joint, made tight with felting previously laced permanently in place, or with red lead. When the remaining two sections have also been bolted, the barge is lowered into the water, where deck plates, motors—if self-propelled—hatches, etc., are added as in the right foreground. If, alternatively to the machinery layout shown, no cabin is required, the hydraulic propelling motor is placed vertically on the deck, with shaft through hull to spur wheels running in an oil bath, and placed outside hull, and immediately before the propeller, leaving the entire under-deck space for cargo.

A little thought will serve to show the many advantages of the system. Apart from the cheap export of barges, a steamer with cargo for a wild up-country district, served by a big river, would thus assemble her barges, load them, and upon their return with raw material, reverse the process, loading their cargoes into her holds, and stowing them in turn upon her deck. Two barges can be assembled, floated and completed in about two hours, and this by unskilled native labor. The barges may be self-beached or launched by the ingenious but simple and robust apparatus shown in the left foreground. The bolsters are reversed and placed beneath the bow for unbeaching. Each quarter section may be easily transported on a motor truck if the barges are required for an inland lake.

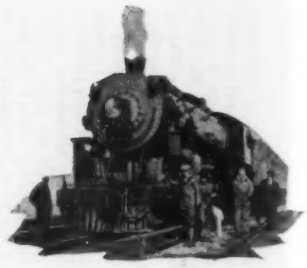
For larger barges up to 500 tons capacity, the special transporting vessel shown on the left, which carries eight in her hold, is provided. A comparison with the 100-foot completed barge seen behind will demonstrate how big an achievement this is. Such barges cannot be disassembled and are therefore riveted in the first place. This is done on a pontoon, alongside. The ship is provided with pneumatic riveting equipment.



An Automatic Hand on the Throttle

Principle and Features of the Sprague System of Automatic Train Control

By S. G. Roberts



THE fact that the Interstate Commerce Commission has made it virtually mandatory that nearly half a hundred of the nation's trunk lines equip their roads with some form of acceptable automatic train-control apparatus, in the name of greater safety, has brought this whole subject sharply to the attention of the public; and the layman, not unnaturally, is seeking enlightenment.

In its effort to satisfy this quest for information, the SCIENTIFIC AMERICAN has in two earlier issues described the Regan and Webb systems, which are made operable primarily by suitable contracts with a succession of track-side elements, termed "ramps"—in principle really a series of third rails placed at definite points along the line where it is desired to initiate the regulation of the train's speed, or to set in motion functions which will cause the train to come to a dead stop if further advance invites a potential disaster.

From what has been said in the preceding articles, it should be clear that the ramps must be from 34 to 120 feet in length; that intimate physical contact must be assured between the ramp and the contacting member or shoe whether the train be moving at low or at high speed; that the shoe must be sturdy enough to withstand impact with the ramp at any speed; and, finally, that the success of either of these systems is largely dependent upon the condition of the third rail at the time of service—*i.e.*, frost, snow, ice, mud, or water must not interfere with the metallic contact between the ramp and the shoe so as to obstruct the flow of a current of electricity essential to the proper working of the train-control installation. These facts are not mentioned by way of criticism, but to bring out certain prerequisites characteristic of all intermittent electrical-contact automatic-train-control systems, of which Regan and Webb are excellent examples of a numerous group, and also to give a background of understanding which shall enable us the better to evaluate the induction type of train control apparatus.

The system selected for presentation in this article is that devised by the well-known electrical engineer Frank J. Sprague in collaboration with his son, F. Desmond Sprague. It represents the fruit of nearly ten years of evolutional labor and the expenditure of close to half a million dollars. A demonstrating installation is now being operated seven hours daily and six days a week on a 5½ mile stretch of track on the New York Central Railroad between Ossining and Tarrytown, New York. Within this span are placed equipment for the functioning of six signal indications; and the traffic over this very busy section of the line includes steam traction and the running of heavy electric locomotives and multiple-unit trains, the latter two drawing energy in the form of direct current from a third rail and using the traffic rails for the return conductor of the circuit. In brief, the electrical circumstances are such as might be expected to put any induction system of train control to tests of the severest character.

Magnetic induction, the twin sister of electricity, is that invisible force or flux which is indispensable to the performance of the telephone, the trolley car, the electric motor, and the great generators which supply current for power, for light, for heat and for other services. The Spragues have turned to magnetic induction to furnish the primary impulse by which diversified reflex actions can be called into play to warn an engine driver of danger and, then, to compel the stopping of his locomotive if he fail to heed the several signals appealing, respectively, to his eye, his ear, and his sense of touch. Magnetic induction is employed because this flux or field can be made to span a gap of 7 or 8 inches and thus obviate physical contact between the locomotive and the roadbed elements of the equipment. Intervening snow or ice, for instance, in nowise lessens the effectiveness of the magnetism reaching upward from the roadbed element to the opposite element, suspended below the locomotive tender, 4 or 5 inches above the tops of the running rails. This clearance is a feature that appeals strongly to the practical railroad man, for there is nothing between or alongside the track to cause trouble by striking pendant train fittings.

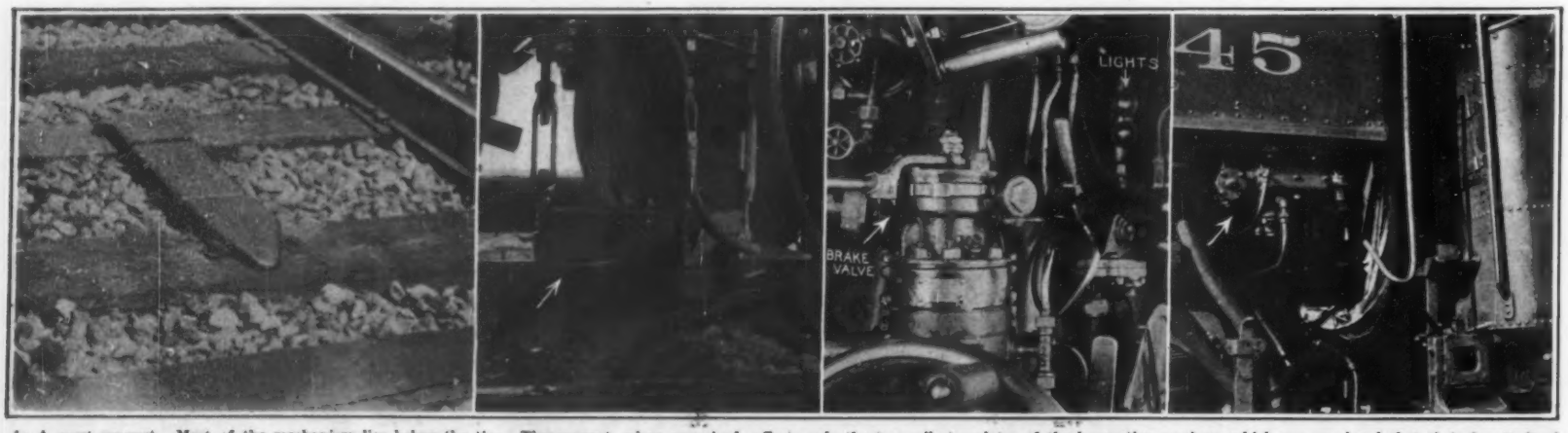
It might be well to emphasize here that the aim of railway management is to maintain schedules and to keep trains continually moving, even though it may be necessary to change their speeds at various points between prescribed stopping places. This is especially desirable when trains are following one another at fairly short intervals, and when a halt of one might bring a number of them to a standstill; involve confusion, if it did not invite accident; and lead to considerable loss of time before all of them were well underway again. These desiderata are of vital importance in the safe handling of "limiteds," made up of several sections, traveling only a few minutes apart, and of traffic generally on approaching or leaving cities or kindred transportational focal points. Therefore, the train control apparatus should leave the engineer in full command so long as he does not ignore the signals transmitted to him in his cab. The Sprague apparatus has, accordingly, been designed to act first as an auxiliary, by repeating, in effect, wayside signals which may be obscured by the condition of the weather or seen imperfectly owing to the velocity of the train, next, to reduce the speed of the train, and, finally, to stop the train if the man at the throttle refuses or is unable to do as he is bidden.

Now let us consider some of the details of the Sprague system and see how the magnets placed between the tracks operate and influence the apparatus installed upon the locomotive and its tender. In each block along the road are fixed two permanent magnets, designed normally to apply the brakes and to act as though danger existed, and a third magnet which is normally dead and whose office is to reset the train equipment after it has passed over and been energized by the two brake-application magnets. These several magnets are subject to the control of the wayside signal system, and obtain their intermittent current from storage batteries which are kept in a proper condition by a "trickling charge" from the alternating current power line of the railroad.

That we may grasp the modus operandi, let us first see what happens when a train enters a block just preceding one displaying a "clear" signal. The brake-application magnets are for the nonce neutralized by an electric current fed to the poles of the magnets agreeably to the position of the semaphore. This current tends to suppress the upward reach of the fields of these permanent magnets, and, therefore, the magnetically responsive receiver located beneath the locomotive can pass through the zone over the magnet poles without being affected. In other words, the train sweeps onward unchecked. Simultaneously, two green lights within the cab shine respectively in front of the engineer and the fireman and indicate that the block ahead is unoccupied.

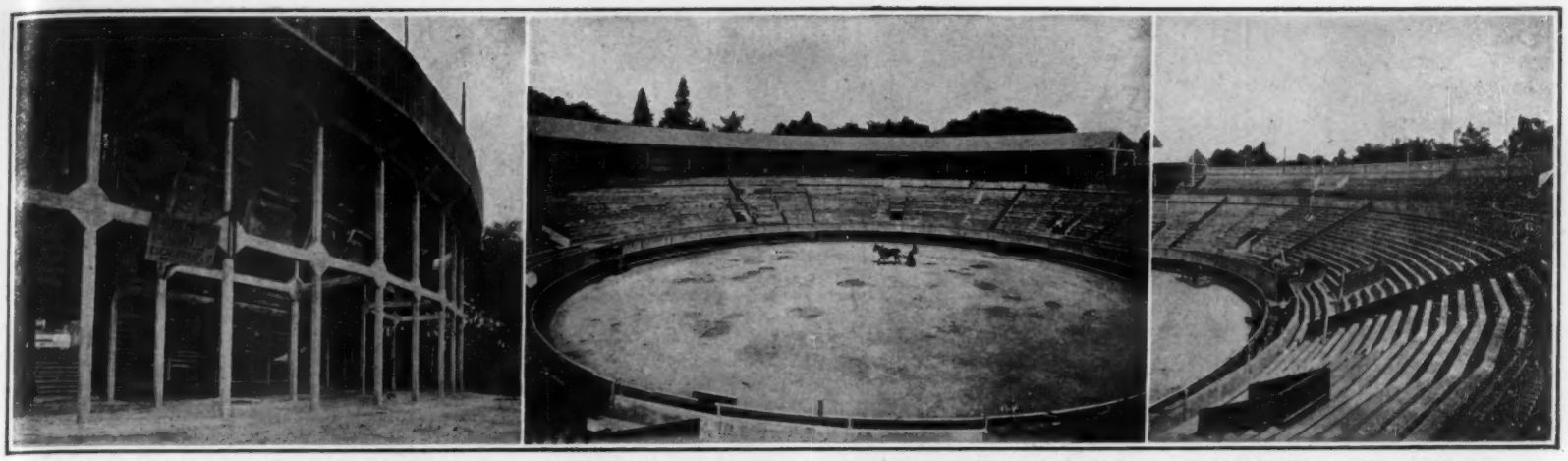
Should the nearing semaphore be at "caution" position, then, shortly after entering that block and on reaching the first of the brake-application magnets, the green lights are extinguished and yellow ones appear in their stead giving warning that the block beyond is occupied and that the speed of the train should be brought within a limit which will enable the engineer to halt it promptly if need be. However, control is not left entirely to the man at the throttle, because, at the same instant, there is initiated an automatic application of the brakes, and this continues until the velocity of the train has been reduced to a predetermined pace. When the brakes are thus operated there is a consequent movement of the brake-valve handle, which the engineer grasps well-nigh continuously, and this shifting of the lever and the sounding of a signal in the cab further arouse the engine driver and the firemen to the situation.

The engineer can, by exerting considerable effort, shove the valve handle so as to release the pressure of the brakes on the wheels, and he may exercise complete control from there on to the beginning of the next block provided he does not exceed "caution" speed. Should he decide to run the risk and let his train go at excess speed, the moment his locomotive passes over the second brake-application magnet the brakes will again automatically come into play and hold vigorously until the train is slowed down to the proper rate of travel. If between the second brake-application magnet and the reset magnet the engineer continues in his wilfulness and allows the train to accelerate dangerously, then upon reaching the reset magnet that magnet, instead of acting to restore the train-control apparatus to normal, is instrumental in invoking an emergency application of the brakes which will suffice to bring the train to a halt. Therefore, the train can not proceed until either the engineer or his fireman descends from the locomotive and presses a button outside and below the overhang of the cab.



1: A reset magnet. Most of the mechanism lies below the ties. The magnet, when energized, affects only the two collector-plates of the locomotive receiver, which are so placed that their longitudinal axes are parallel with that of the reset magnet. 2: The double receiver on the locomotive, seen in its working position at the forward end of the tender. Note that it is well above the rail and clear of any chance obstacle. 3: The engineer's brake-valve and the signal-lights on the right side of the cab. The automatic feature of the valve is only a modest addition surmounting the standard brake-valve equipment. 4: The valve assembly, the brains of the automatic brake mechanism

Some significant details of the Sprague automatic train-control system



Three views of the partially completed bull-fighting arena at Bordeaux, of concrete and steel along distinctly American architectural lines. The finished arena will seat 10,000 persons

So far we have dealt principally with the magnets located on the roadbed and between the rails; and now we shall consider broadly the more intricate features of the system carried by the locomotive and its tender. While some of these are exquisitely sensitive to electrical or magnetic impulses still they have been so designed that they are for all practical purposes extremely rugged and capable of withstanding the jarring and the movements inherent to railroading. Beneath the forward end of the tender, and hung by adjustable supports, there is a box-like affair fitted with four horizontal, flat, iron wings so arranged that two of them extend parallel with the track and two of them parallel with the ties. These are known as "collector plates," and are, respectively, responsive to the reset and the brake-application magnets.

The heart of this so-called "double receiver" is made up of moving armatures, small metal bodies, which generally close certain electric circuits, but which open or break these circuits when they are acted upon by the magnetic field or flux of any of the brake-application magnets. Some idea of the sensitiveness of the heart of the receiver can be gathered from the fact that when a locomotive is running at high speed past the pole pieces of a magnet, the collector plates sweep through the magnetic field in from 1/100th to 1/150th of a second of time. Even so, the magnetic impulse is picked up, the right armature is shifted, and one or more predetermined functions are discharged aboard the locomotive.

The circuits that are made or broken by the magnetically-inspired motions of the receiver armatures, send electrical impulses to a metal box, mounted on one of the running boards of the locomotive, containing an assembly of three coils. These relays, which may be likened to nerve centers, and which respond to electrical impulses as short as 1/1000th of a second, call into play electrical currents strong enough to regulate the action of two "pilot control-valves." These valves, in their turn, vent to the atmosphere compressed air from one or the other of two piston chambers, and the consequent travel of a ported valve determines when and how the brakes shall be applied throughout the train.

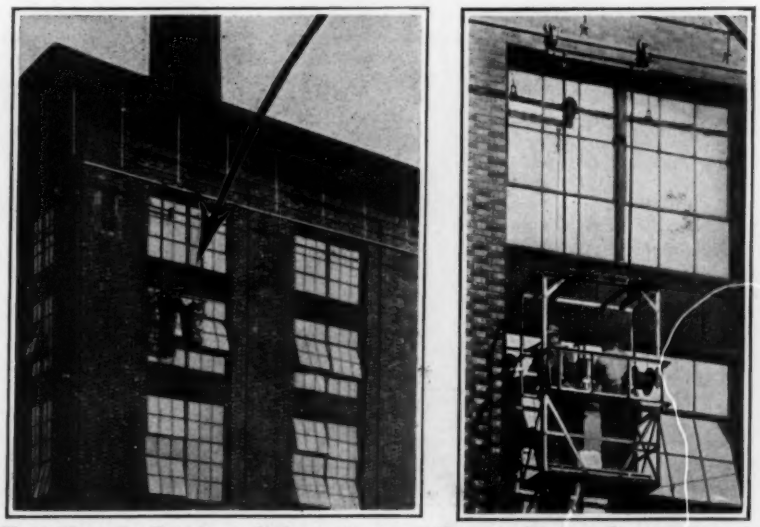
Indeed, this aggregation of valves may, fittingly, be described as the very brains of the locomotive's automatic train-control equipment, because these valves, according to the requirements of a road, may be set so as to bring about a sequence of diversified operations. For example, they may be adjusted to meet any desired combination of light and heavy application of the brakes under ordinary service conditions as well as to give an emergency application of the brakes, under speed control, with or without enforced stopping, or with the privilege of proceeding at reduced speed until all automatic control of the braking is released. In brief, the engineer may enjoy a rather wide range of freedom of action provided he does not overstep the bounds that are fixed by the valves and designed to assure a reasonable margin of safety.

Up to the present nothing has been said about the speed-control mechanism which takes command of the situation whenever the engine driver refuses to heed either the wayside or the cab signals or when, by sheer strength, he holds the handle of the brake valve at "release" when the automatic apparatus has brought about a speed-reducing application of the brakes. The speed-control mechanism is contained in a metal box, supported at one end like the body of a wheelbarrow, by an extension of the axle of one of the forward trucks of the locomotive, and held up at the other end by a spring suspension. The mechanism is geared to the axle extension, and the speed of the latter reacts upon a centrifugal governor whose axial movement changes the relations of certain fixed and movable contacts. As may be imagined, this governor and the associate contacts can be arranged or regulated so as to perform their parts at predetermined maximum speeds, and, what is equally important, according to the braking needs of freight or of passenger trains.

While this necessarily superficial presentation of the Sprague system probably conveys an idea of complexity to the average person, still the apparatus has fewer parts than the air-brake equipment carried beneath every first-class passenger coach. After ten years of experimenting, and a painstaking study of practical railroading requirements, an automatic-train-control installation has been devised which is no less rugged and no harder to maintain in proper working order than the air-brake outfit, which is accepted by the public as a matter of course. The device indicates the condition of any block when entered and, therefore, warns of the traffic state of the block ahead—*i.e.*, a caution block always meaning a "danger" or occupied block next in line. If these warnings are not heeded by the engineer, the automatic apparatus supplants him.

For the automatic stop, or, to use the more comprehensive term, the automatic train-control, to exert its full effects in promoting the safety of railroad travel, there must be present the concomitants of a good block signal system at the roadside and a thoroughly reliable and powerful airbrake on the train.

Of these two the block signals are the more highly developed and function with the greater regularity. This is due, in part, to the fact that railway engineers have been longer at work perfecting signalling, and in part to the greater simplicity of the problem.



The safe and efficient method of cleaning windows, showing the carriage at close-up as well as a general view of it in place on the building

Concrete-and-Steel Stadium Construction in France

THE first of the truly modern amphitheaters of concrete and steel dates back hardly more than ten years. Yet in this brief period the type of construction mentioned has spread with a rapidity that is truly remarkable. We have big-league ball parks and many of those in the larger minor leagues; college stadiums of which the Yale Bowl is the outstanding example; and soon we shall have as a climax the new park of the New York American League club, which will be built in installments and will, when fully finished, accommodate no less than 85,000 spectators.

Nor is the concrete-and-steel amphitheater restricted to this country. As evidence of this we offer the accompanying views of a bull-fighting arena now approaching completion near Bordeaux. It may be news to many of our readers that the national sport of Spain is practiced in southern France as well, but such is the case. The capacity of the Bordeaux arena is, at first thought, disappointing; but it must be remembered that the "playing field" is altogether smaller than that of the more familiar American athletic ground or baseball field, and that it is the size of the field which determines the perimeter of the inner circle of concrete, and hence the capacity of stands of a given height. In all essential respects, as our photographs make clear, this arena is a miniature of the American stadium.

Heat Treatment of Duralumin

THE well-known German light alloy, duralumin, which is much used in late automotive construction, can be refined and toughened by quenching as well as by cooling in the air. Strange to say, however, it must be allowed to season for four days after the heat treatment is completed. An approved quenching bath for duralumin consists of a 10 per cent solution of sodium hydrate at 30 degrees Cent. in which the metal is allowed to remain for five minutes. This is followed by a bath consisting of three parts of nitric acid, one part of sulphuric acid and twelve parts of water. The parts must be well rinsed.

The Window-Cleaning Carriage

AMONG the familiar figures of the industrial life of the city is the window cleaner. Hazardous to a degree, his occupation is not particularly difficult or, indeed, extremely dangerous, so long as he keeps his harness where it should be—provided his cleaning be confined to the skyscraper of conventional design, with its single windows and broad stone sills. But what about the huge modern factory, whose entire side is glass save for enough steel to hold it together? This offers the cleaner a brand new problem, and one for which we had not seen any successful solution until the device pictured herewith came to our attention. Under the eaves there is run a sturdy rail, and on this there runs a roller-frame, from which is suspended a big carriage as shown in our photographs. The cleaners travel in this carriage, which can be raised or lowered at will, and which is sufficiently well balanced to be propelled along the side of the building with ease. There is no harness, no uncertain hold on non-existent sills, and no inaccessible area of glass.

Left: Casting the imitation stone sections in the studio workshop. Plaster is poured into the mold and fiber is pressed into the semi-liquid mass in order to bind the plaster cast together. Here the workmen are seen spreading out the fiber over the plaster in the mold. *Right:* The various plaster stone sections, having been cut out along the lines of the "stones," are mounted by means of fastening wires to a grill framework, and then painted to give a realistic appearance

The "reel" stone, but actually real plaster, walls of the photoplay castle in the making

Castles of Plaster and Steel

How Engineering Methods are Being Introduced in the Building of Motion Picture Sets

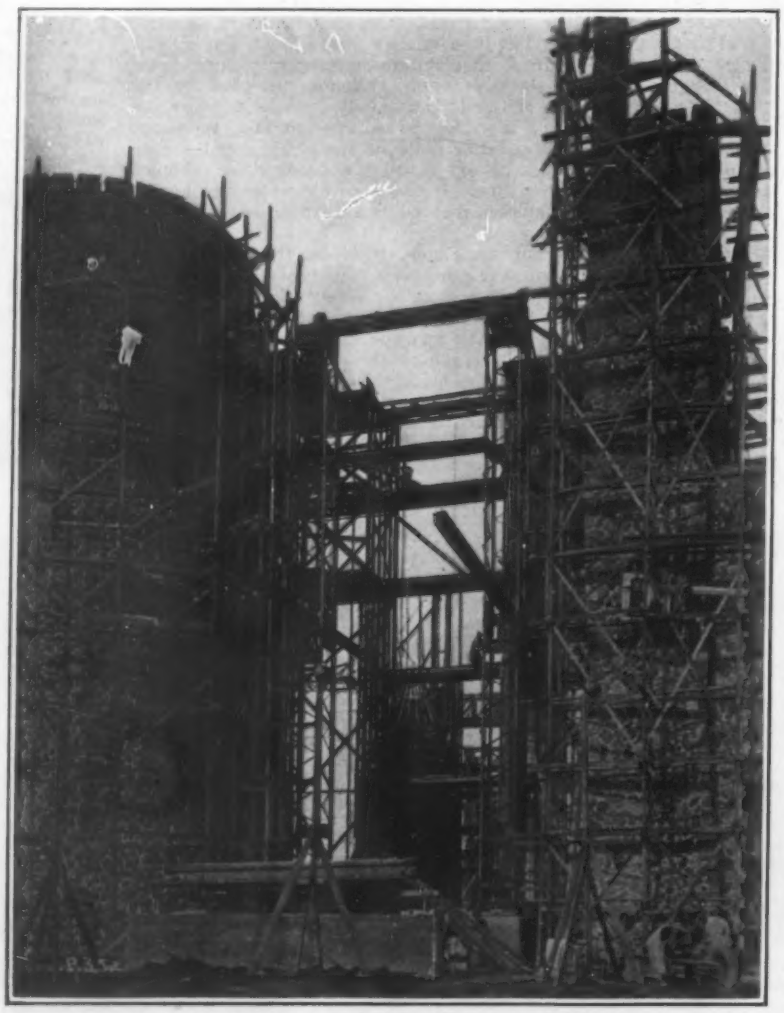
By Delbert E. Davenport

REALISM is the keynote of the modern motion picture. In that respect it differs widely from the legitimate stage, where scenery is merely an approximation or even an explanation to an audience whose imagination must supply the necessary details. In the photoplay production, however, nothing is left to the imagination. A castle, for instance, must be a castle and not a mere painted canvas background. And when the sets, as the made-to-order sceneries of the photoplay are called, are of huge proportions, real engineering methods have to be resorted to, in addition to artistic and ingenious capabilities; and thereon hangs a new chapter in the story of the motion picture art.

Scientific engineering has been resorted to at last as an indispensable need in the construction work coincidental to the making of screen plays—scientific engineering of the same order as that required in the real world. Indeed, when Douglas Fairbanks, the well-known film comedian, recently decided to produce a photoplay version of the immortal "Robin Hood" and was confronted with the necessity of building a large replica of a medieval castle, he discovered that the work was getting beyond the usual studio carpenters and mechanics, and into the realm of structural engineering. Hence he summoned one Fred L. Baker, chief engineer and head of a local iron works, whom, with the aid of a corps of assistants, planned and constructed the drawbridge and adjoining castle walls.

Now there is nothing unusual about building a small drawbridge of steel. Throughout the country there are numerous structures of this kind. But in the case of the drawbridge for this make-believe castle, it was not only necessary to build a structure of sufficient strength and capacity to hold all the soldiers and horses which its dimensions would permit, but in addition it was necessary to make the structure a part of a comparatively frail wall of plaster. It was the latter feature which made the task unusually difficult even for the ingenious motion picture mechanics; for the drawbridge had to fit into the general scheme of the castle while in reality it had to be made a separate structure, properly braced and supported by cleverly hidden means.

The castle drawbridge had to be raised and lowered with precision. It had to appear as a part of the castle, even though the latter could not support any additional weight because of its frail plaster construction. So the iron builders went to work and made the bridge an entirely independent structure, with lattice-work towers and steel guys ingeniously and thoroughly concealed from the gaze of the inquisitive motion picture camera.



Structural steel work being erected independently of the frail plaster walls of the castle, in order to support the large drawbridge

As a foundation for the drawbridge, excavations were made for two 12-foot concrete blocks upon which two lattice angle-iron columns, constituting the main supports, were placed. These columns were 3½ feet square and 59 feet high. Three 12-inch I-beams were used to hold them apart. The first I-beam was 30 feet from the base, the second 46 feet and the third 59 feet. On a 3-inch steel shaft were built two 12-inch I-beams, each 43½ feet in length, which formed the walking beam, making the bridge 28 feet long and 20 feet 8 inches wide over all. Two tons of pig iron were used as a counter-weight for this entire structure.

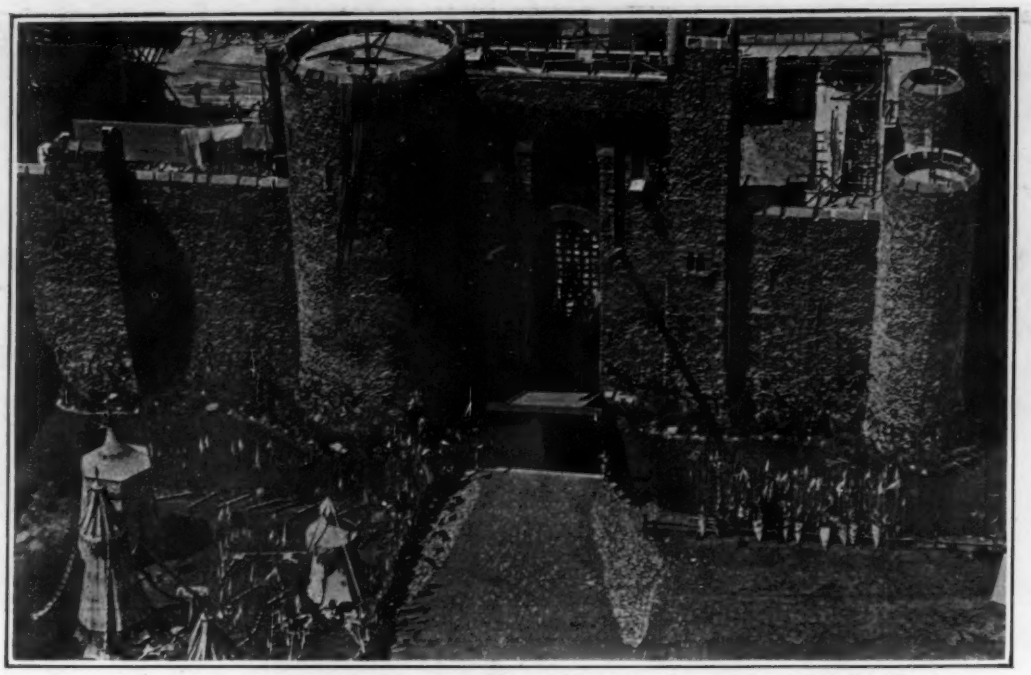
The bridge proper was hinged on a 3-inch steel shaft set in iron bushings fastened to the concrete footings. The bridge floor consisted of four I-beams with a 4-inch web and a 10-inch flange. These were held apart by three channel irons 4 feet 3 inches long each. The web on them was 4 inches and the flange 10 inches. All this was bolted together, riveting being avoided in order to facilitate the task of knocking down the whole structure. The bridge floor itself was not counter-weighted, because an ample excavation could not be made on account of the nature of the ground.

The make-believe drawbridge was hoisted by a 1-inch cable which ran over a 12-inch sheave wheel 30 feet from the ground, and from there back down to the base of the columns and underground to a 10-ton electric hoisting machine. Wherever exposed this cable was painted black to prevent it from photographing; so that as far as the audience is concerned two large link chains, which did photograph, apparently bear the strain of the hoisting. Yet these chains were not altogether impractical, as they were made of 3-inch steel tubing electrically bent and welded, each link being 18 inches long. The reason this chain could not be made of less sturdy material was that in the course of the action of the story, Mr. Fairbanks had to climb up one of these chains in order to gain entrance to the castle through a window some 50-odd feet from the ground. Hence the chains had to be sufficiently strong to support the weight of his body while in the strenuous motion of ascending with the aid of hands and feet.

It is interesting to note here that all the steel in this bridge had to be con-

cealed with boxed-in wood, because drawbridges of 800 years ago were not constructed of steel. At every two feet on the beams, which support the floor of the bridge, a 1-inch hole was drilled for the purpose of bolting on a 4-inch planking which made up the visible surface. Masking boards, 1 inch by 12 inches and 1 inch by 6 inches, were used to hide the steel work. Even the bolt heads were masked over to give them the appearance of wooden pegs.

Another interesting feature of the make-believe castle was the operation of the portcullis, or sliding gate, which was so arranged that it operated either in conjunction with the drawbridge or independently of it. This portcullis was 35 feet high and 12 feet wide, and weighed 1½ tons. It was made to slide up and down at will by means of the same hoist as that controlling the bridge. The arrangement was such that the portcullis rose as the bridge lowered or vice versa, or it could be moved either way independently.



General view of the medieval castle built for a photoplay version of "Robin Hood"

A system of electric light signals and a special telephone line were installed so the director of the picture could control all this mechanical action from a point a quarter of a mile away, from which distance some of the so-called "long shots" were filmed by the cameraman. The mere pushing of a small button set the machinery into motion.

The interior castle walls required a total of 178,000 square feet of wall board, plaster board and button lath. A solid concrete floor of vari-colored blocks gave the large banquet hall a most realistic appearance.

The exterior walls of the castle were built of matted sections of plaster molded and painted to resemble uneven brown stones, and these sections were wired to a grill framework 300 feet in height. The frame was constructed of standard lengths of lumber only. Wire was used for the attaching process in order to make it easy to dismantle the sections of plaster after the picture was finished, and also to avoid filling the lumber in the framework with nail holes, thus saving it for salvage. A total of 252 tons of plaster and 1500 sacks of cement were used and 736,000 feet of lumber was required for the frame. A total of 254 100-pound bales of fiber held the plaster together. This entire "set" was braced with overhead cables which cleared the whole structure and were fastened to buried weights.

Explosion Chambers as Defense Against Torpedoes

THE object of torpedo attack is to smash an opening through the side of a ship which shall cause the flooding of a maximum amount of its interior; so great a degree of flooding, indeed, as shall disable the ship and probably sink her. Among the many methods of defense which have been tried out, none has proved so successful as those which are carried by the ship itself, and preferably are built into the very structure of the vessel.

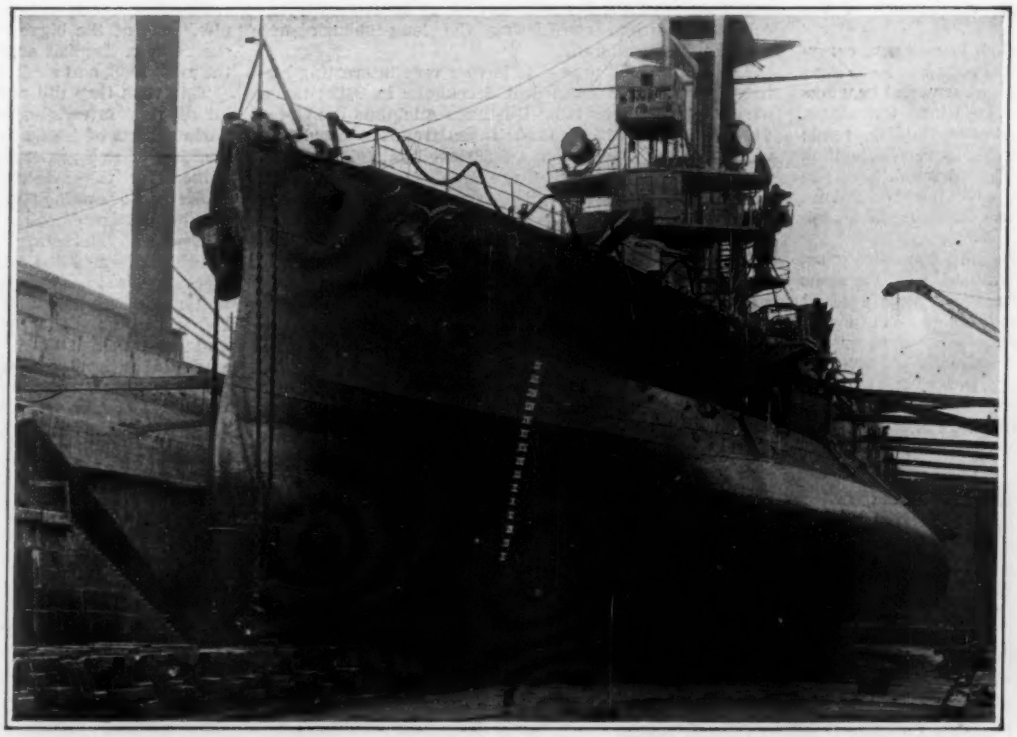
Early in this experimental work it was realized that in no possible way could the terrific burst of the torpedo explosive be prevented from breaking through any ordinary structure by which the rush of the torpedo was arrested. The great mass of white-heat gases liberated under a pressure of several hundred tons per square inch, and restrained by the mass of water behind, above, below, and on each side of the torpedo, would inevitably find its way in the direction of least resistance—and that would be in the direction of the hollow interior of the ship. Steel armor plate, no matter what its thickness might be, would be no protection; since the enormous pressure developed would simply tear the armor plate away from its position and blow it bodily into the interior of the ship.

So it can be realized that the only protection—and that only a partial protection—would be to provide large hollow, interior explosion chambers, in which the gases could expand and lose their enormous pressure. As the art of anti-torpedo defense developed, we find that the naval architect provided within the hull of the ship what might be called internal expansion chambers—that is, wide spaces built up of structural steel and minutely sub-divided, so as to present a complex cellular structure upon the wrecking of which the gases of the T.N.T. were expected to expand their energy, without breaking entirely through into the large interior compartments. This is the method which has been consistently followed by our own naval constructors, and it has been carried to such a degree that, in our latest battleships of the "Maryland" class, there are five distinct, parallel walls of steel, all watertight, which the torpedo, or rather its gases, would have to break through before reaching the large central compartments containing the vital elements of the ship; namely, the steering gear, engines, boilers, magazines, etc.

Early in the war the British found that the Germans were so greatly increasing the torpedo warhead charge, that none of their existing ships were capable of withstanding its deadly effects. We all remember how one submarine in the course of an attack, quickly sank a 12,000-ton armored cruiser of the British, and subsequently, within the hour sank two other sister-ships, as they were rescuing the crew of the disabled vessel. Later, again, the up-to-date battleship "Audacious" was sunk by a torpedo, or mine, and although she remained afloat for many hours, ultimately the blow proved to be her death wound, and she sank while being towed to harbor.

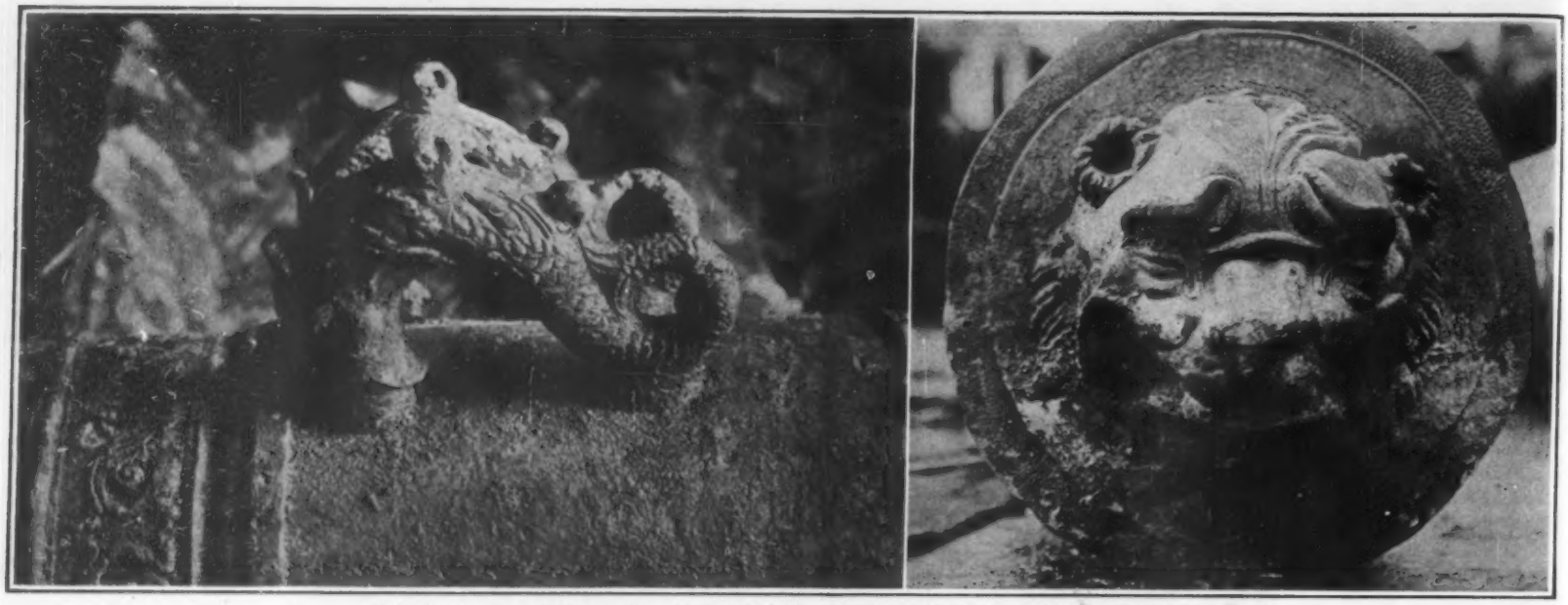
In looking around for some means of protection, the British constructors hit upon the plan of building a large explosion chamber on the exterior of the hull, shaping it in the form of a semi-circular bulge, or blister, as it used to be called. This, in the case of the monitors, which were designed to shell the German fortifications in Belgium, and also for the Dardanelles expedition, was 10 feet in width, and it was extended throughout the vital portions of the ships for about two-thirds or three-quarters of their length. The device proved to be very efficient, and several of these monitors were torpedoed without being sunk, and indeed without being so disabled as to be entirely put out of the fighting.

The bulge, of which we show a very good illustration, taken when the warship was in drydock, had the disadvantage that it added to the displacement and reduced the speed of the ship. This was true even in cases where the bulge had been incorporated in the original design, and therefore was given the best possible streamlines for speed. The 42,000-ton battleship "Hood" was designed in this way, and after we came into the war her plans were opened for the inspection of our own naval designers, with the result that the designs of our own six battle cruisers were modified by incorporating a modified form of the bulge. The result was a large increase in the beam and displacement of our ships, and a consequent reduction in their speed. In adopting the bulge, our constructors made certain modifications over the English practice, extending it throughout the whole length of the vessel and thereby securing refinement of form.



Warship in dock, showing the form of the anti-torpedo bulge. This gave good service during the war. Now abandoned in favor of internal expansion chambers within the ship

Nevertheless, it is probable that in the future capital ships that are built either by the British or ourselves, will be built with the explosion chambers incorporated within the ship itself. That is to say, except for an increase of beam, the middle of the ship will not be distorted by any exterior bulged form. It is claimed, and we think justly, that battleships of the "Maryland" type could take the blow of several torpedoes, without being completely disabled, although there would, of course, be a considerable loss of speed.



Left: Dolphins on a Polish gun from 1623. *Right:* The butt end of a Swedish gun dating back to 1500

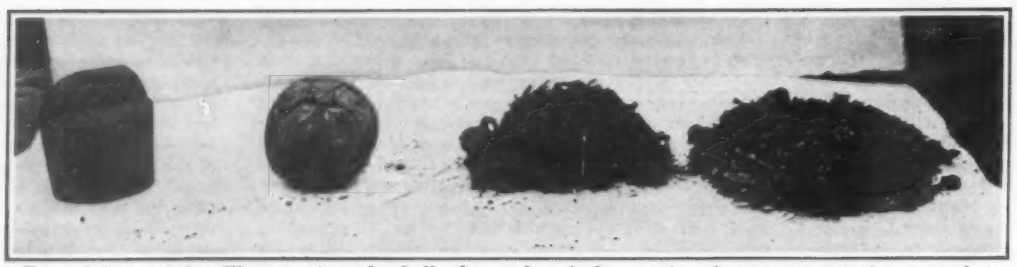
Treasure trove from olden times brought up from the bottom of the sea

The Sea as a Safe Deposit Vault

Relics of the Past Being Brought to Light by a Swedish Salving Concern

By L. Staekell

SOME time ago a Swedish salvage ship anchored to ride out a storm, close to a small island in the south part of the archipelago off Stockholm. A fisherman who had lost a small grapnel close to the ship asked for help, and a diver was sent down. The drag was soon found, caught in an old gun. The diver searched for more relics and found another gun. The two were hoisted up on board the ship, taken into Stockholm, and turned over to the experts for identification of their period of origin and appraisal of their value. It turned out to be an easy task to assign the find to the proper period and to reconstruct the history of the salvaged artillery.



From left to right: The tompion, the ball, the wad and the powder that came out of a gun that had lain for centuries beneath the sea

One of them proved to be a Polish bronze gun, carrying the date 1623 and weighing 2926 pounds. Both guns were beautifully ornamented and had armorial bearings with the arms of Johan Welher Palatinus Culmensis, 1623. The inscription, translated into English, read: "With the help of God I was founded by Gerdt Bennich in Danzig in the holy year." This Bennich was one of the most famous gunfounders of Germany or Poland during the seventeenth century and lived in the Polish town of Danzig.

Two days later the same diver found five more guns, of which three were still more valuable; at the same time were found two big anchors, of the type used by the Swedish men-of-war during the seventeenth century. One of these guns was an old Swedish gun of the year 1535, weighing about 1900 pounds. Afterwards the author discovered in one of the royal archives that it was the first big bronze gun made in Sweden after the restoration of King Gustavus I. There was also another Polish gun, a very fine specimen of the sixteenth century, dated 1555 and weighing 2650 pounds. This gun is beautifully ornamented with the Royal Polish coat of arms, and it bears an inscription in Latin, an English translation of which would be: "Falcon is my name; with my crooked beak I annihilate all; and in my mouth I carry a terrific thunderbolt. Beware!" The four others were Swedish bronze guns, dated 1560, 1612, 1617 and 1624. All the material—the two guns first found, the five of the second search, and as well the relics brought up in the same and other places as the result of a continuance of the investigation—was in uniformly excellent condition, considering the long submergence which it had suffered.

The gun of 1612 proved to have a very interesting history, having been founded at Stockholm in 1612; taken over to Germany by King Gustavus Adolphus the Great during his war with Poland; taken from the Swedes in action by the Polish General Prince Radzivil in 1622, and at last taken back by the Swedes sometime in the years 1626-27. The English translation of the Latin inscription says: "This gun, which has obtained a badge and the name Södermanland, was taken on that occasion when the town of Mitau was taken from the Swedes under command of Kristoffer Radzivil, Duke of Birze and Dubienka, commander-in-chief of the Grand Duchy of Lithuania, in the year 1622." It was quite customary at this time to inscribe lengthy accounts of the adventures, special virtues, etc., of guns upon the metal; for artillery was still enough of a novelty for the individuality of each piece to be a matter of interest.

Further investigation proved that the guns belonged to an old Swedish man-of-war, "Riksnyckelen," which foundered in the neighborhood of Stockholm in the year 1628. When the guns were cleaned and examined the powder and balls were in good order, being protected by wooden tampions. This is probably one of the greatest and most valuable recoveries of ancient guns during the last hundred years. They have been purchased by the Swedish Government. Meanwhile the salvaging company continued to examine other places where it was known that old shipwrecks were to be found.

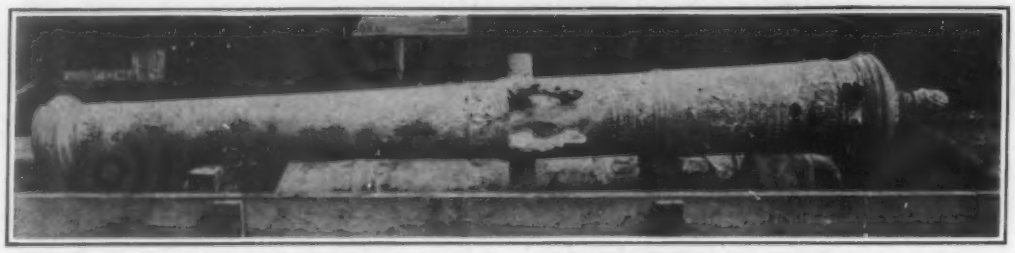
The first wreck to be examined was the old "Riksäpplet," one of the biggest Swedish men-of-war, built by the famous English shipbuilder Franciscus Sheldon in the year 1663, and sunk not far from Stockholm in 1676.

This time they did not find any guns, but, instead, a lot of very interesting ornaments, blocks, stonewares, various sorts of ammunition, and so forth. Also a huge quantity of well-preserved black oak, which is especially valued for the manufacture of high-class furniture. In Europe beautiful furniture is made from such black or blue seadrunk oak.

The most interesting was perhaps the find of an old fire-ship, "Den Gröne Jägaren," not far from the above-mentioned ship. This vessel is standing on the sea-bottom, 90 feet below the surface, just as it sunk about 250 years ago. The masts are lying not far from it, and on deck is still to be seen the anchor cable, still wound about the horizontal wooden capstan.

From this ship the diver has taken up a small three-pounder iron gun with its carriage. If the ship proves to be in good order, it is possible that it may be raised and brought on shore. Ships from 1652 are not seen every day. What will be found this summer it is impossible to say; but it is the salvage company's intention, if possible, to examine an old wreck of 1660, which is said to inclose the luggage that belonged to a Swedish ambassador to Poland.

The divers may perhaps find some old pieces of silver and old coins of different sorts. It is also known that the ambassadors of those times brought with them



A Polish gun 300 years old, brought up from a watery grave

valuable gifts, generally fine specimens of workmanship, in gold and silver. Some years ago there was also found an old wreck off the town of Gothenburg which was investigated, and the result was one of the finest collections of old china consisting of many hundred pieces worth many hundred thousand crowns.

The work of the salvaging company is therefore followed with great interest by the whole country.

Specifications for China Tableware

THE Bureau of Standards has been conducting some tests of chinaware of the type used in most hotels and restaurants. Such ware is subjected to very severe use, and there was practically no scientific information available concerning the relative durability of different kinds of china. As the amount of money invested in this class of material is quite large, any work which will tend to produce a better and more durable variety of tableware is well worth while.

Many varieties of ware from this and other countries have already been tested by the Bureau, but, of course, even the large amount of work already done represents but a small portion of the different kinds of china in actual use. However, based solely upon these results, it would appear that domestic hotel china is superior to the German, French and English in ability to withstand sudden blows as indicated by impact tests. In this respect also, the American vitreous china and earthenware for household use are also much superior to the French, German and Japanese ware upon which tests have been carried out.

In regard to crazing and cracking from sudden temperature change, the American hotel wares did not craze and cracked only at the highest temperatures used in the test. The English wares crazed easily, but did not crack, while the French and German wares did not craze but cracked at the lower temperatures used in the test. The American earthenware, with some exceptions, did not craze during the standard test, but crazed at the higher temperatures which were employed for comparison. Although the French, German and Japanese household wares did not craze, they fractured from sudden thermal shock.

It has been found that the design of the rolled edge and the angle of inclination of the rim of hotel plates has as much effect on the ability to withstand chipping as the properties of the body from which the plate is made. The glazes now in use appear to be sufficiently well constituted chemically to withstand the alkaline solutions used in dish washing.

Physical Energy and Biology

THE body of a living organism is *not* in equilibrium with its surroundings. In other words, the living body (and also the dead body, for some time after death, as popularly conceived), in its natural environment, is a source of available energy.

Though not in equilibrium with its surroundings, the living body is in an approximately steady state; furthermore, it is one of the essential conditions for the continuance of life that this approximately steady state be maintained. Extreme departures therefrom result in permanent displacement from the steady state,

A pedestal (newly) made of old black oak from a Swedish man-of-war that has been on the sea-bottom for 350 years

and ultimately in the dissipation of the available energy presented in the substance of the organism.

In the course of events a certain amount of available energy, varying according to the nature of the organism, is unavoidably dissipated, per unit of time. It follows that every organism, in order to maintain the steady state necessary for its survival, must be provided with devices for capturing available energy. Furthermore, in the competition which takes place among organisms, the advantage must go to those whose energy-capturing devices are most effective in directing available energy into such channels as are favorable to the preservation of the species.

In man, as an organism of the animal type, A. J. Lotka, writing in Proceedings of the National Academy of Science, points out that the mechanism for capturing available energy comprises three elements:

Sense Organs, or Receptors, whose function is to establish a certain rather close correlation between the state of the environment and that of the individual. Their function, in fact, is to *depict* the external world in the organism, to apprise him of the state of his environment.

Organs of Operation, or Effectors, such as hands, feet, etc., by means of which the individual reacts physically upon his environment so as to modify it, or to modify his relation to it, as, for instance, by locomotion.

Organs and Faculties of Adjustment, or Adjustors, whereby the action of the Effectors is adjusted in accordance with the indications furnished by the sense organs (receptors), and with the needs of the organism.

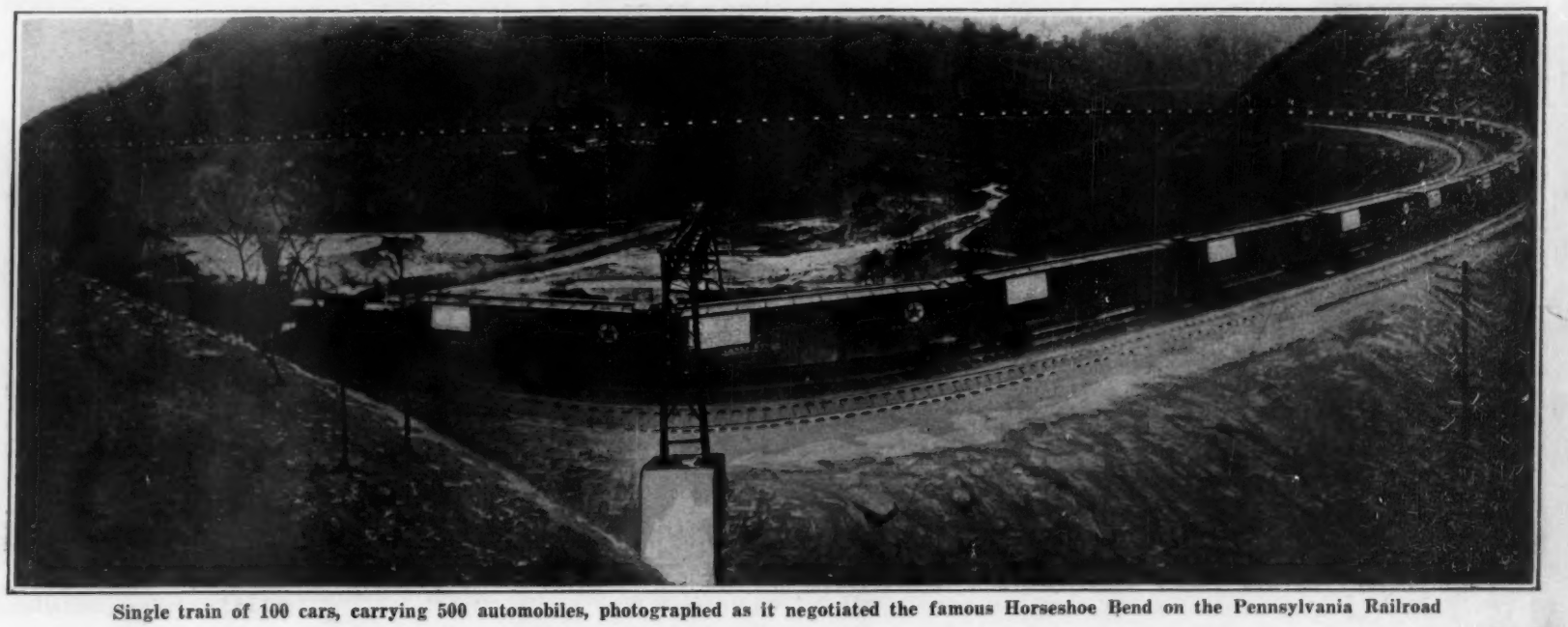
Among these adjustor faculties one which figures prominently and plays an important rôle is what we may call the *sense of values*, that faculty which we exercise when we are confronted with two or more alternative courses of action, from which one must be selected. In such a situation we choose the course which appears to us, subjectively, the more *desirable*, and we do not ordinarily give any thought to the question as to what may be, objectively, the significance of "desirability," any more than we do ordinarily concern ourselves, in viewing a landscape, as to the particular wave-length, the objective characteristic, of the light which to our subjective judgment appears "green."

And yet, for the interest of the species, it is evidently far from indifferent what may be the objective characteristics of those things which to us appear, subjectively, desirable. Upon the proper adjustment of the sense of values, of the "tastes," to certain objective realities depends the welfare of the species.

A 100-Car Train on the Horseshoe Curve

HERE we show a single train of 100 cars, containing the largest trans-continental shipment of freight, of any description, ever made. The train was made up of 100 Pennsylvania Railroad System automobile cars, each containing five automobiles. The train was assembled in the Greenville yard, New Jersey, on the Pennsylvania Railroad, and left that point on Monday, January 2, and was operated as a single unit over the system's lines to Chicago. The train was kept intact and was moved as a single unit from Greenville, N. J., to Ogden, Utah, a distance of 2387 miles. At Ogden it was broken into two 50-car trains, leaving via the Southern Pacific lines on Tuesday morning, January 17, and arriving in Sacramento Thursday morning, January 19. The 100 cars arrived at Sacramento with both the cars and their content of automobiles in good condition. The total mileage from Greenville to Sacramento was 3080 miles, and the total time consumed in making the trip was 17 days. On the Pennsylvania System the train was held over night at Harrisburg, two days at Altoona, one night at Pittsburgh, and one night at Chicago. It was delivered to the Chicago, Milwaukee and St. Paul Railroad by way of the Union Station, Chicago.

The trip over the lines of the Pennsylvania Railroad System was made with two engines at the head of the train and two pushers at the rear. In our photograph it is just barely possible to see the engines at the front, and one of the pushers at the rear. These locomotives weigh 503,100 pounds apiece. The train was 4809 feet long, and its weight was 8,476,400 pounds.

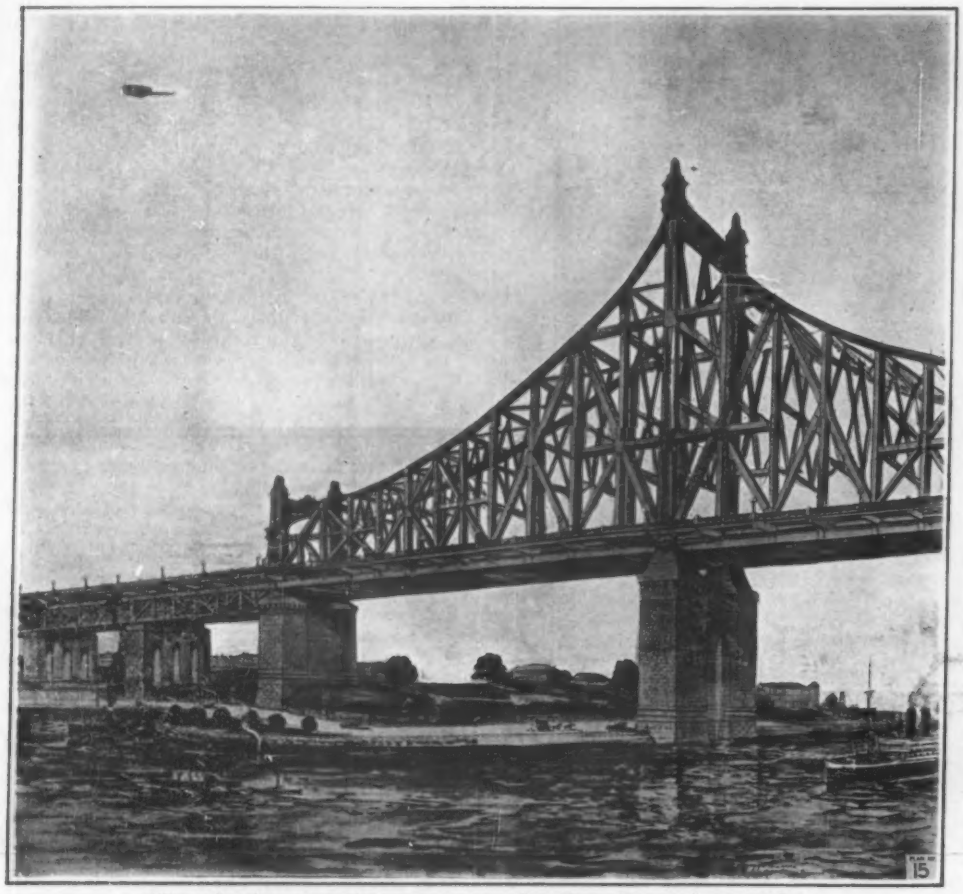


Single train of 100 cars, carrying 500 automobiles, photographed as it negotiated the famous Horseshoe Bend on the Pennsylvania Railroad

The Syd Har

An Australian Engi Work

J. Risd



View showing an anchor arm, main and anchor piers, and approach

BEFORE describing this great undertaking, a few preliminary remarks on the subject of big-span steel bridges generally may be of interest.

Subject to certain reservations, the weight of steelwork in the main girders or trusses of a bridge increases roughly as the square of the span between supports. This must not, however, be taken as a general rule, for the weight may increase at a greater or less rate in proportion to the span, according to the type of bridge, the loads to be carried, and the quality and strength of the steel used. Again, in small spans the weight of the load, such as a locomotive, is greater than that of the bridge, whilst the effect of wind may be negligible, but in big spans the weight of steelwork is much greater than that of the load carried, and wind pressure becomes a very serious consideration. In the case of the Forth Bridge, the stresses produced in the principal members were approximately in the following proportions:

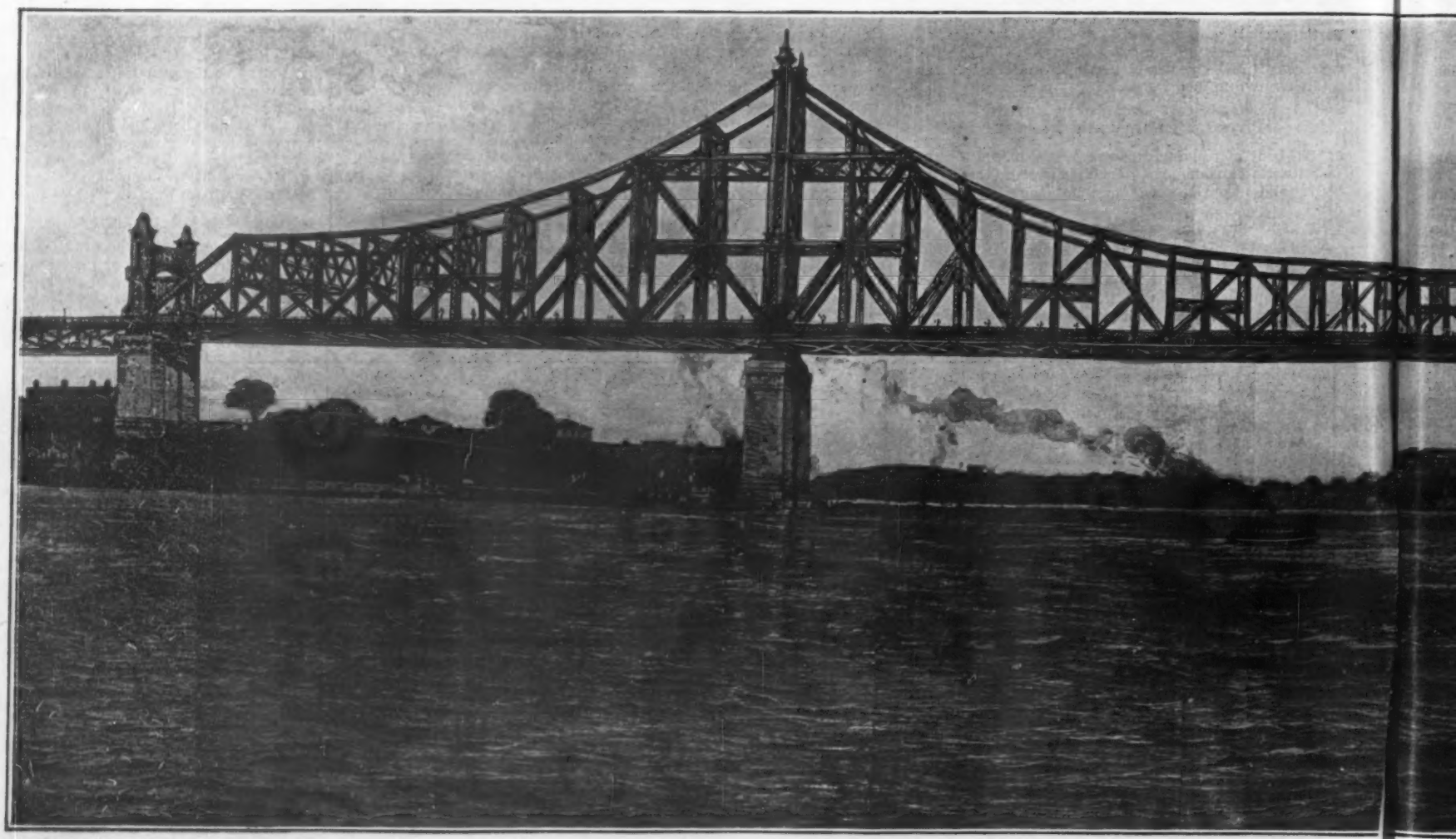
Stresses due to wind pressure	2920	tons
Stresses due to weight of the bridge....	2282	"
Stresses due to weight of trains.....	1022	"
	6224	"

from which it is clear that wind pressure was the most important and the load (*i. e.*, trains) carried by far the least important factor in the cost of the bridge.

When a bridge engineer has a *necessarily* big span under consideration, the selection of design is of great importance, and is determined largely by the position, depth and nature of the supports and foundations. For crossing a deep river, for instance, say 3000 feet wide, a favorable condition for a cantilever bridge would be the occurrence of two islands of solid rock at a distance of about 750 feet from each bank. On these islands piers would be built, and either the cantilever or suspension type would be adopted. The suspension type possesses the characteristic that the cables or links which support the load need elaborate stiffening to prevent local distortion as a heavy tram crosses the bridge. The cantilever type, if not the most economical, is suitable for big spans up to 1800 feet. It facilitates erection of enormous quantities of steelwork in th er deep porary support ection the question. of met a suspension bri possible as to render th type pr of inability to own w wind pressure.

Communicati opposit Harbor is at pr ined by ing proved ina coping has been decid the ha narrowest poin ers are for the supply ork invo will be betwee t and M bridge will be 3 g. At o structure there e ordina each of from 2 et in le end there will pproach to 194 feet.

The main por bridge tilever type wi span of anchor spans o ch. Th consist of a pai r arms, supporting the s ot girde at Dawes Point's Point load, and the sh be anch piers to provide unbalan load on the riv re will h 100 feet deep a and risi 270 feet over th ese trus spaced 98 feet 6 t, center connected trans gid brac cross-girders an ich will traffic and tra eight to There will be a adient of end of the brid e to the foot central sp e clear



This is the age of long-span bridges. Here are views of the massive cantilever structure, which is to be built at Sydney, Australia, across an arm of the harbor. ... central will be four railway and trolley track ys, and on

Sydney Harbor Bridge

Engineering Work of the First Magnitude

J. Risdon

rk in the deep water, when tem- support section are entirely out of stion. It of mention, however, that nsion bri possible for a span so large ender the type prohibitive by reason ility to own weight and to resist ressure.

unicatio opposite sides of Sydney is at pre ined by ferries. These hav- ved ina coping with the traffic, it n decide the harbor at one of its est poin ers are now being invited supply work involved. The crossing between t and Milson's Point. The will be 3 g. At one end of the main re there e ordinary approach spans, from 2 et in length. At the other re will pproach spans of from 168 eet.

main po bridge will be of the can- type wi span of 1600 feet and two spans o ch. The central span will of a pai r arms, each 500 feet long, ing the oot girders. The two piers es Point s Point will carry all the d the sh be anchored to the anchor provide unbalanced weight of and the rive re will be two main trusses deep a and rising to a height of over th ese trusses, which will be 08 feet 6 t, center to center, will be ed trans gid bracing and by heavy rders an ich will directly carry the nd tran ight to the main trusses. ill be an dient of 1 to 40 from each the brid g to the level on the 600- ntral spa clear height above high spring tide level will be 170 feet, to permit of the passage of the tallest masted vessels.

Although the clear span will be 200 feet less than the 1800-foot span of the Quebec Bridge, and 110 feet less than the 1710-foot span of the Forth Bridge, it will carry heavier loads, as will be seen on reference to the following table in which other interesting comparisons will be found:

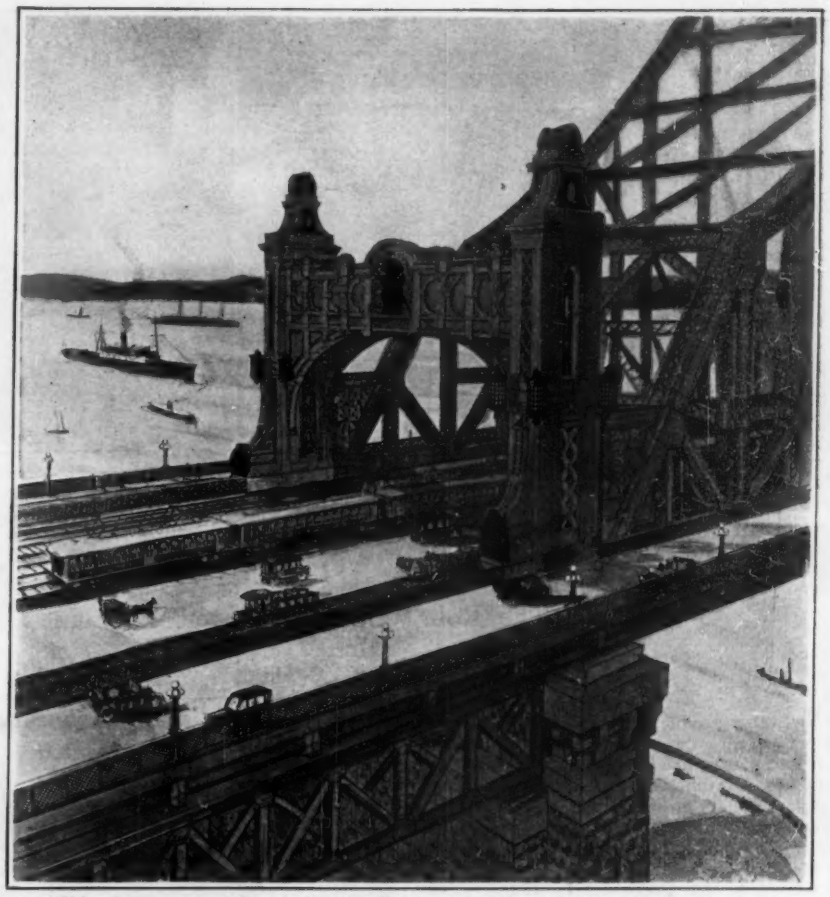
Name of bridge.	Type.	Total length in feet.	Maximum clear span in feet.	Height from water level in feet.	Number of railway and trolley tracks.	Number of 9-ft. roadways.	Number of footwalks.
Sydney Harbor	Cantilever	3816	1600	170	4	6	1
Forth	"	8295	1710	150	2	..	..
Quebec	"	3240	1800	150	2	..	2
Brooklyn	Suspension	5989	1595	135	4	2	1
Williamsburg	"	7200	1600	135	6	4	2
Manhattan	"	6855	1470	135	8	4	2
Hudson River	"	10,000	3240	..	16	16	2
Delaware River	"	3536	1750	135	4	6	2

The Forth Bridge, opened in 1890, took seven years to construct, and the Quebec Bridge, opened in 1917, took 18 years to construct in consequence of two appalling disasters that occurred during erection. It is estimated that the Sydney Harbor Bridge will be completed in seven years.

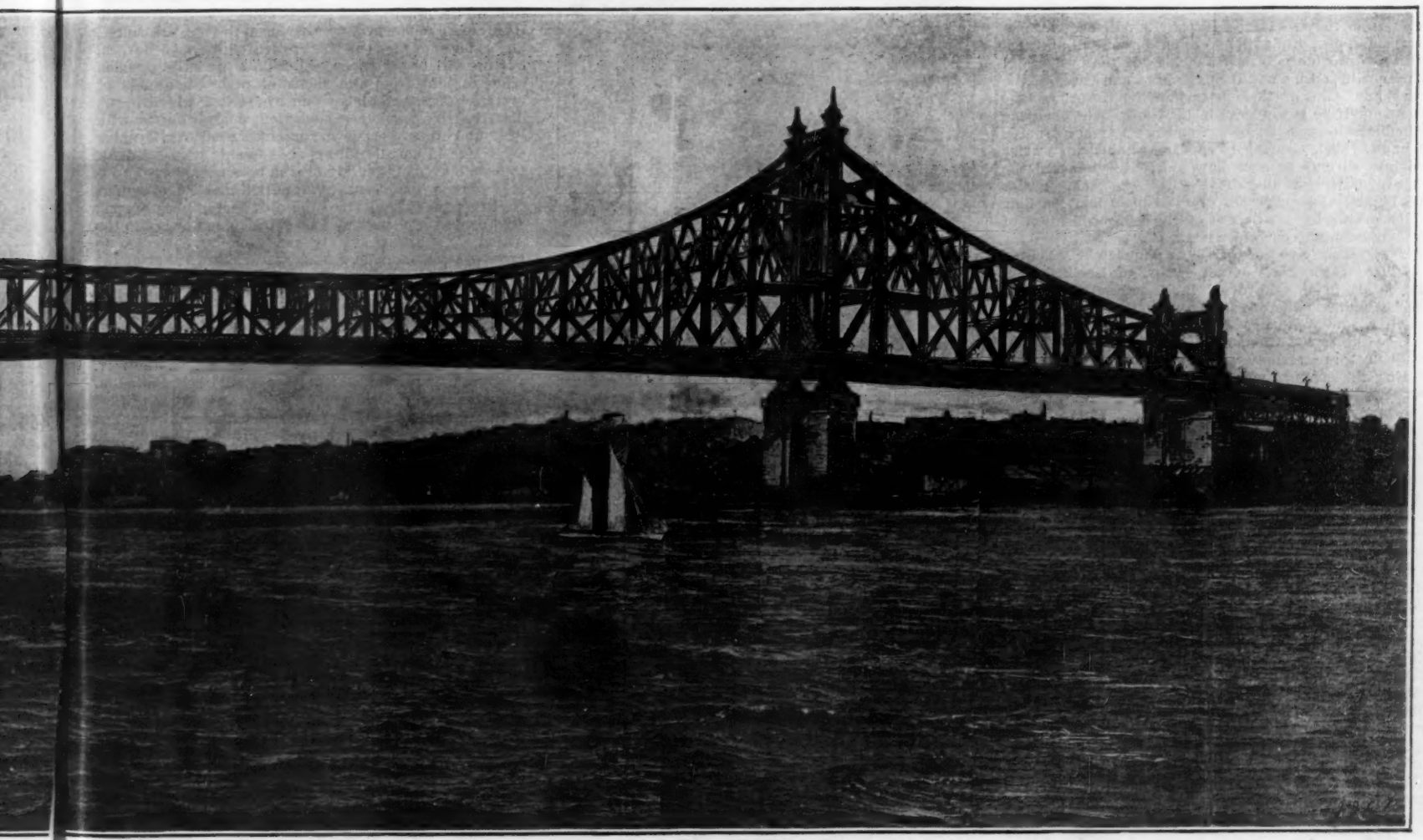
Between the main trusses there will be four railway tracks of standard 4-foot 8½-inch gage, and a roadway 35 feet wide for heavy traffic—all at the same level. Outside the main trusses and supported on cantilever cross-girders projecting from them, there will be another roadway on one side 18 feet wide for fast motor traffic, and a footwalk 15 feet wide on the other side.

In designing the bridge wind pressure has been allowed for on the basis of 30 pounds to the square foot of all surfaces exposed to it, including those of trains and other vehicles, in addition to the superficial area of the steelwork. This pressure is equal to that pro-

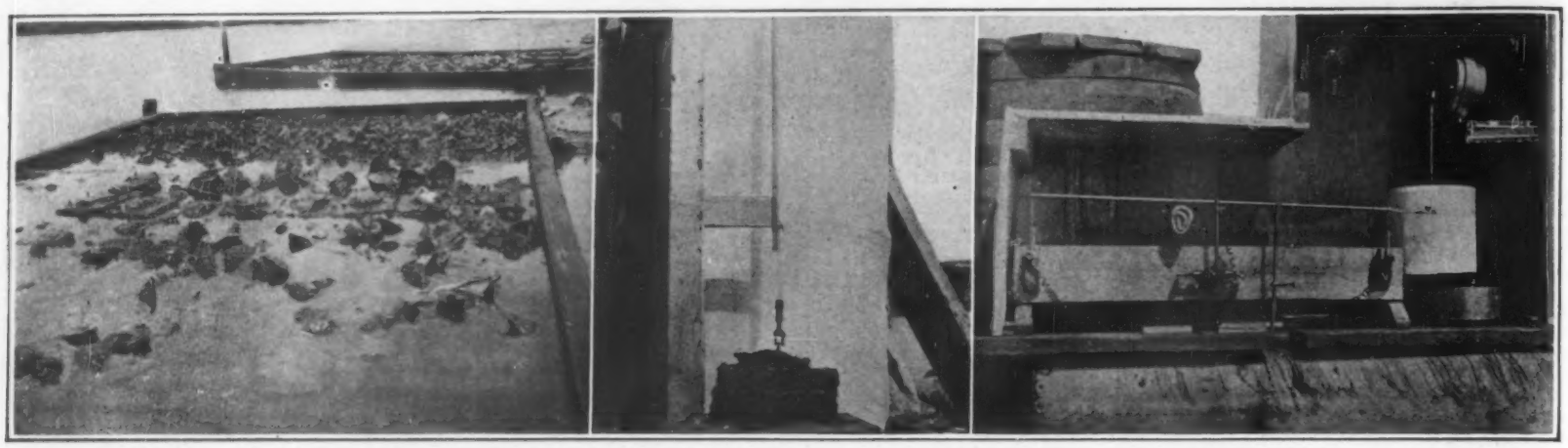
(Continued on page 216)



This shows a portal and the distribution of railway tracks, and roadways



bor. central span of 1600 feet, and two anchor arms of 500 feet span. The center span is 100 feet deep at center and rises to 270 feet over the piers. The capacity track , and one walk for foot passengers



Left: The platform on which hundreds of oysters gave up the secrets of their lives. *Center:* How the oyster was fastened that acted as recorder and sentinel for the entire lot. *Right:* The revolving drum, the pen, and the electrical contact with which the New Jersey oyster produced his autobiography

Investigating the life secrets and life processes of the "succulent bivalve"

The Missing Link in Seaboard Sanitation

The Role Which the Oyster May Some Day Play in the Conservation of Waste

By Wyman Smith

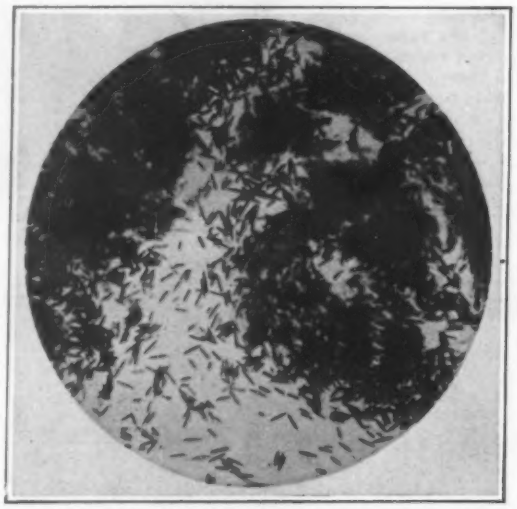
NOT only does the oyster industry of the United States produce food worth fifteen million dollars every year, or the equivalent of four hundred thousand dressed steers, but by feeding on the plant growth and plankton of the seaboard, the oyster is a tremendous conservator of what would otherwise be waste. At work 20 hours a day, the oyster is everlastingly busy eating, and thus saving, the plant and animal growth which thrives on the nitrates and other essential salts produced by the decomposition of sewage or brought to the seaboard by the ground water leaching from the land.

The oyster is the final link in a great "biological machine." Sewage brought from a source hundreds of miles from the sea is acted upon by putrefactive bacteria and a host of plant and animal forms—all agencies acting to provide a bountiful feast for the oyster and other shellfish which wait in the bays and coves of the coast line. But if the oyster and his coworkers are absent, or if he is hindered in his life growth, then the valuable salts pass on to sea and are lost as a source of human food. During recent times industrial wastes fed into various streams have not only disturbed the mature oyster but they have stifled the young oyster "seed" and thus may destroy the biological machine which ordinarily takes care of the self-purification of the streams and coastal waters.

"For nearly five years," says Thurlow C. Nelson, biologist of the New Jersey Board of Shellfisheries, "no young oysters have set in New England waters and the industry there is facing extinction. The streams which a few years ago disposed of large volumes of sewage can now no longer do so, with the result that the banks are strewn with heaps of putrid matter. During the summer months these accumulated wastes swarm with flies, adding to the dangers of the situation. The study of conditions in our coastal waters shows the approach of a national calamity.

"Under favorable conditions," Mr. Nelson continues, "a small stream may dispose of the sewage of a relatively large population, and the stream in turn be supplied with a constant source of animal and plant nutriment. There is a true fertilizing action on the water, with a resultant large increase in the number of organisms present. Since fish and shellfish utilize these plant and animal organisms as food, it follows that the addition of domestic sewage to a body of water will result ultimately in an increase in human food in the form of fish and shellfish derived therefrom as truly as though the sewage were employed in fertilizing land crops. Shellfish growing in waters contaminated with human wastes are usually very fat, not as is ordinarily supposed because they are eating sewage, but owing to the great number of food organisms which in turn are deriving their nutriment from the products of the decomposition of the sewage."

For months Mr. Nelson has watched the movements of oysters on the New Jersey coast. He has tagged them, measured the breathing, the times of opening and closing for the shell, and even the amount of water strained during a day. For the oyster eats its food by passing large quantities of seawater through its gills, being very much awake and active during flood tide, but eating so little during the ebb that the stomach is usually found empty at the end of low water. Two oysters with stomachs thus empty were examined at low tide and then watched carefully until their shells opened at the flood water. For an hour they were allowed to feed, and a finger bowl of the water was dipped up every few minutes from that which passed. The oysters were then taken up, their stomachs washed and the protozoans, the food most abundant in the sea at the time, were counted.



A few of the 56 million guests that inhabit the oyster's shell

The number found compared with that dipped up in the finger bowl showed that an oyster three or four inches long strained nearly six quarts of water an hour, or, based on his average working day of 20 hours, nearly a barrel of water a day.

Luckily, however, the oyster does not entirely depend upon the food brought him from the sea—he has a private garden on his own shell, a "veritable zoologist's paradise, for on it may be found representatives of every phyllum in the animal kingdom." One oyster's shell which was examined showed that on it had been carried over 56,000,000 diatoms. As nearly all the species move about, their own movement, together with that of the waves, wafts them in a steady stream to the oyster's gills whenever they open to feed. Of course, an oyster may not eat the growth of his own garden, but he will be recompensed by large quantities which come to him from the shells of other thousands of oysters. The water above an oyster bed which is not disturbed by some foreign noxious matter teems with life, and thus is shown another need for keeping the water in such condition that it may grow food for the shellfish lying quietly on the bottom.

If present conditions continue we may have regular "oyster farms" similar to those of Italy, where young seed oysters are suspended on ropes hung down into the water. Not every locality can even then propose to grow oysters, for where fresh water dilutes that of the sea too much, the oyster refuses to feed. Even though he become lean and poor the oyster persists in keeping his shell shut under such conditions. While oysters have no difficulty in feeding from roily water, providing it does not cover them with mud, they find a hard bottom, swift currents, and a raised place on the reef, free from mud and shifting sands, the best suited to the fattening process.

Natural influences have made a considerable portion of our eastern coast line particularly well adapted to oyster raising, and it is those portions which need expect to promote the oyster industry of the future. As a great link in the disposal of city sewage, the oyster has rarely been mentioned, but just as surely as inland cities may feed their garbage to the hogs, so may the seaboard cities learn to fatten oysters by supplying the plants from which they feed with proper fertilizer. Our diffident bivalve has become an important part of the great "biological machine," but yet he needs careful "herding."

The black lines show limits of shells when growth was started, 122 days before these pictures were taken

Oysters grow rapidly, and tend to correct any imperfections in their own shells

Physical Properties of Tetryl

MESSRS. C. A. Taylor and Wm. H. Rinkenbach, assistant explosive chemists, in a study of the physical properties of tetryl, being conducted at Pittsburgh, Pa., by the Bureau of Mines, have completed solubility data for tetryl in carbon tetrachloride, making determinations with wagon pipette. The method consists simply in weighing a sample of the solution taken at equilibrium at a constant temperature, evaporating off the solvent and weighing the residual tetryl.

Legendary Islands of the Atlantic

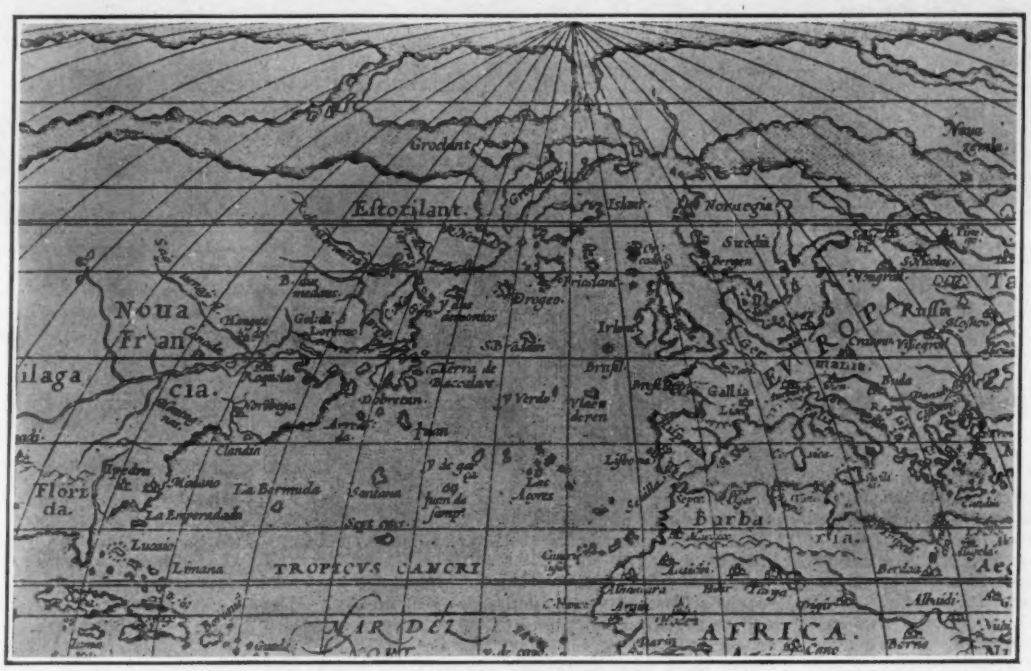
A Brief Account of the Brain-Storms of the Medieval Map-Makers

THE sea has always had a romantic interest, and by far the largest share of this has been centered about the Atlantic. The Mediterranean, much as its terrors might be advertised and magnified, was after all a closed sea fairly well known to the sailors of antiquity. But the moment one passed through the gates of Gibraltar, one entered upon a dark and unknown and unknowable mystery, and mankind's credulity would have to be far less than it is if he were to avoid the temptation to hang all sorts of marvelous tales upon the hook thus afforded his imagination.

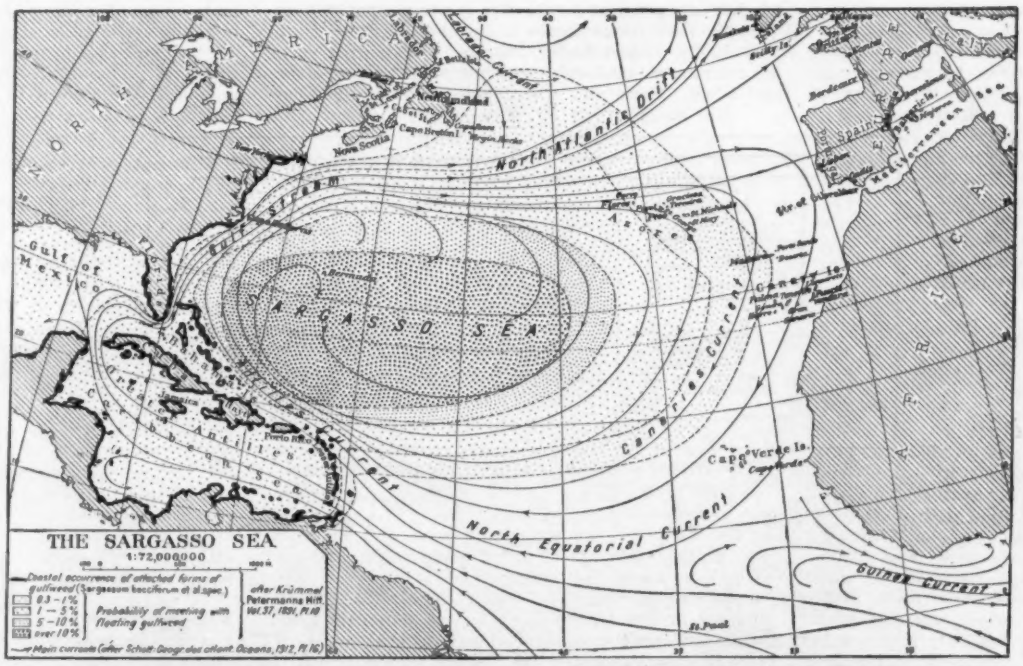
From the earliest times of which we know anything at all there have been wonderful islands somewhere in the Atlantic. The Phoenicians in ancient days and from the south, the Irish and Norse in the early middle ages and from the north, were sufficiently daring seamen to venture forth upon the dark and mysterious waters to the westward; but they must nevertheless have done this with trepidation. They must have been very easily frightened and very easily impressed; and they must have been the most untrustworthy witnesses of what they had seen — especially with no human possibility of their being successfully contradicted. And then, there *are* islands in the Atlantic. There are the Azores, the Canaries, the Madeiras; and at the north there are Greenland, Newfoundland, etc. It needed little foundation in fact to give birth to the wildest tales. And to top these off nothing could have been more conclusive than the testimony of those few elect who had by any chance got far enough west to experience the terrors of the Sargasso Sea. We need never be puzzled to account for the origin of Atlantis and its brother myths.

As early as Plato's time the Atlantis myth was current in full glory, and the tale included a war between Athens and Atlantis some 9000 years previously, followed by the destruction of the island by a cataclysm of some sort. Without space to chronicle all references to the subject, we must at least pause upon the St. Brendan explorations. It seems likely that the Irish navigator actually visited some remote islands in some quarter of the Atlantic. Another chronicler of surpassing industry was Edrisi, the Moor, who wrought a world-map in silver somewhere about 1154, for King Robert of Sicily. He shows on this a few of the Atlantic islands, and indicates his belief in no less than 27,000 of them. He seems to have had some acquaintance with the authentic groups.

The American Geographical Society has just published, in its Research Series, a volume, "Legendary Islands of the Atlantic," by William H. Babcock, which goes very thoroughly into all angles of this fascinating subject. The author is particularly thorough in tracing the various "islands" down through the hands of the medieval map-makers. Of all the legendary islands, and island names, Mayda has been the most enduring. The shape of this island has generally approximated a crescent; its site most often has been far west of lower Brittany and more or less nearly southwest of Ireland; the spelling has varied to Maida, Mayd, Mayde, Asmaida, or Asmayda. The island had other names also earlier and later and between times, but the identity is fairly clear. As a geographical item it is very persistent indeed. Humboldt, about 1836, remarked that out of eleven such islands which he might mention, only two, Mayda and Brazil Rock, maintain themselves on modern charts. In a note he instances the world map of John Purdy of 1834. However, this was not the end; for a relief map published in Chicago and bearing a notice of copyright of 1906, exhibits Mayda! Possibly this is intended to have an educational and historic bearing, but it seems to be shown in simple credulity, a crowning instance of cartographic conservation.



A section of Ortelius' world map of 1570, showing the ideas of this period as to the legendary islands and other regions



Map of Sargasso Sea, illustrating its possible bearing on the medieval belief in the existence of lands or islands in the Atlantic

Brazil Rock or Brazil Island, just mentioned, is a conspicuously complex problem. The name is apparently Gaelic in origin, and is spelled variously Brasil, Bersil, Brazir, O'Brazil, O'Brassil and Breasail. As a personal name it has been common in Ireland from the earliest days. The name is freely distributed over the face of the Atlantic, clinging especially to the Azores group. A circular form and a location westward from southerly Ireland are shown on many maps. Mr. Babcock identifies it, in this location, with Newfoundland, which was almost certainly visited at an early date by Irish voyagers. The name does not appear before 1325, but maps showing the Atlantic and its remoter islands can hardly be said to have existed earlier. And a confusion between Newfoundland and the Azores in this period is hardly more reprehensible than the uncertainty among present-day authorities as to the exact location and even the actual existence of certain South Sea islands.

An interesting chapter of Mr. Babcock's book deals with Greenland, or Green Island; another with Markland, or Newfoundland. The "islands of Zeno," dating from the "Zeno" map of 1558, are fully discussed. Another chapter is devoted to Antillia and the Antilles, which appear on so early a map as that of Pareto in 1455. We find also a chapter on the sunken island of Buss and other phantom islands. Strange to say, we have quite full reports of the Island of Buss in the old accounts of voyages, and this island persisted on maps for a very long time. After discussing many minor islands, Mr. Babcock summarizes the whole sum of our knowledge as follows:

Atlantis was a creation of philosophic romance, incited and aided by miscellaneous data out of history, tradition, and known physical phenomena, especially by rumors of the weed-encumbered, windless, dead waters of the Sargasso Sea. There never was any such gorgeous and dominant Atlantic power as the Atlantis of Plato, able to overrun and conquer more than half of the Mediterranean and contend with Athens in a struggle of life and death.

St. Brendan did not cross the Atlantic nor discover any island in its remoter reaches, where some maps show islands bearing his name. He seems, however, to have visited divers eastern Atlantic islands, now well known; and it is quite likely that most of the portolan maps of the fourteenth and early fifteenth centuries are right in linking his name especially to Madeira and her neighbors.

Brazil Island probably represents the region around the Gulf of St. Lawrence, brought on the same parallel unduly near the Irish shore. Thus understood, it would be, presumably, but not necessarily, the cartographic record of some early Irish voyage far to the westward.

Man, or Mayda, is frequently a more southern and western companion of Brazil Island on the old maps.

Left: Each sailbeam of this electric windmill measures 22x36 feet; and by turning the slats the sails can be thrown into or out of the wind. *Center:* Modern Danish farm with windmill to generate electric power. *Right:* An electric windmill of another type on a Danish farm

How the farmers of Denmark have set the wind to work

Electrically Harnessing the Winds

Yoking Windmills to Motors to Produce Light, Heat and Power for Farm and Rural Communities

By Ivan C. Waterbury

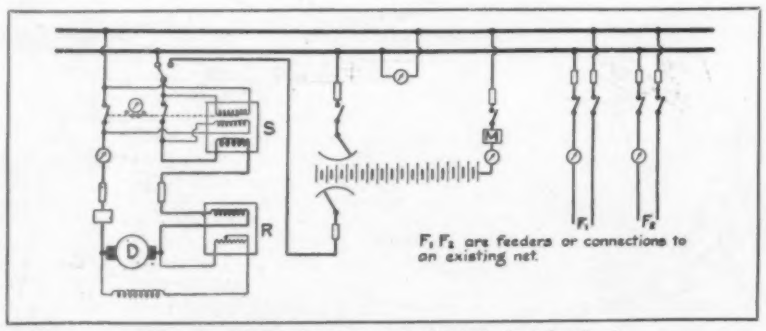
HIGHLY applicable to American farms and especially to isolated communities in the prairie and desert states, where there is lack of water power, of coal and of oil, are the wind turbines recently brought to remarkable efficiency in Denmark and France. Cooperation by small Danish communities is in several instances supplying the local electric works with one-fifth to one-half of all power needed. Where many an American farmer is groping about his night chores with a lantern, his Danish contemporary turns on the electric light supplied and stored by his windmill. Because of this storage capacity, even a lull or a calm need not keep him from the power-operation of any stationary appliance, from a grindstone or a churn to a threshing machine.

Denmark, lying open to the sweep of sea breezes, affords conditions highly favorable to success with wind-driven electrical plants. But many parts of the United States are shown by official weather statistics to be fully as good for the purpose. Taking the range from 4 to 18 miles per hour as that through which the wind is of utility, and noting that the full year contains 8760 hours, it is interesting to compare the wind schedule of Denmark with that of certain parts of the United States. Denmark enjoys winds between the limits indicated for 6660 hours per year—75 per cent of the time. Practically the same showing is made by the winds at Atlanta, Cleveland, Wichita; at El Paso and at Devils Lake, N. D., there are 6000 hours or more per year within the desired range; Des Moines shows 5600 and San Francisco, 5300; and of the cities reported, Salt Lake City brings up the rear of those having available winds more than half the time with 4500 hours per year. In addition, it is to be noted that Cleveland, Wichita, El Paso and Devils Lake show from 1300 to 700 hours per year of winds in excess of the upper limit of 18 miles per hour, from which much utility can be derived by proper apparatus. On the whole, then, it appears that our winds are fully as favorable in many localities as those of Denmark, which have been so extensively and so successfully harnessed.

The high annual average of working-wind hours shown for El Paso holds good for large areas of New Mexico. The average shown for Wichita is no more favorable than that prevailing throughout Kansas, Nebraska and most of South Dakota. Even in the cyclone belt of these States and Iowa, non-electrical windmills are widely used. Apparatus like that in use in France and Denmark would be even more proof against the whirlwinds while harnessing the winds. Not only are the wings so modelled that they automatically turn their edges toward the wind's eye when the blast is too strong, but also the motor machinery is automatically regulated so that winds of almost any velocity are available.

Electric windmills are widely used in Holland to operate drainage plants. This is the cheapest and most effective means of reclamation for wet lands. It requires little attention and consumes no fuel. The size of the wind-motor and of the water-screw needed are determined by formulae. As the model of wind-motor must have a certain diameter of wheel, area of wings, and number of wings, so the water-screw it must operate requires a certain diameter and length of core, lifting-height, and capacity in a given velocity of wind; also the grade of the water-screw and the number and pitch of its threads are important factors.

Such installations would make cheap irrigation-stations in the Desert States and good reclamation-works for draining slough-lands along our Northwestern rivers and lakes. These and other applications of their current would so greatly extend the availability of modern conveniences as to revolutionize the life of agricultural communities remote from the producing centers of coal, oil or hydroelectricity, and even from railroads. Electrically-lighted country schoolhouses would be a great stimulus to social and cultural organization in neighborhoods where the chief social activity is an occasional dancing party. Danish wind-motors produce from 1.1 to 76.7 horsepower, according to the size of the machine and the velocity of the wind. This capacity can be indefinitely increased by hitching a number of windmill-motors together in series to drive several sets of machinery, or to store up supplies of juice to light larger communities.



The circuit details of a typical wind-electric plant

Comparatively little power is needed to supply an ordinary farm or small village with water, and it is easily furnished by the usual pumping windmill 5 to 16 feet in diameter. But the use of windmills for power complicates the issue. The huge diameter needed to offset the low efficiency of the wheel was generally found to make the cost of manufacture so great that it did not pay to invest in a wind-power plant. Moreover, wheels of great diameter proved difficult to regulate and drive machines with a jerky motion. These faults were first rectified largely by two young Danish engineers, Povl Vinding and R. J. Jensen.

The natural way of getting work out of a wind-pressure is by letting the wind act on a plane. Vinding and Jensen found that by the old method of letting the plane move in the direction of the wind, only 17 per cent of the energy contained in the air-current is gathered, much better effects resulting from setting the plane at an angle to the wind-direction, so that the plane can move sideways. Later, still better results came of using a wing with an angular section, in which the angle is about 160 degrees and the lengths of the two parts forming the angle are in the proportion 3:1. Windmills of this form give by far the best results, if the number of sails does not exceed six for large mills or four or five for smaller wheels.

Great improvements in the form of the wing were made by modifying the airplane propeller, as developed in the war-time experiments, to suit the special purpose of the wind-motor. A wind-catch built on this principle lets the wind-current strike the section of the wing and leave it without eddies or detrimental suctions. Thus the new sectional form of the wind-motor wing makes its specific efficiency 2½ times as great as that of the wing with the angular section. For converting wind-power into electrical energy an ordinary shunt machine with "flexible" transmission between the wind-motor and the generator is used. Eventually it was found that to attain the highest efficiency the energy from one or more wind-motor-driven generators should be conducted into an existing high- or low-tensioned electric-wire system working parallel to the generator.

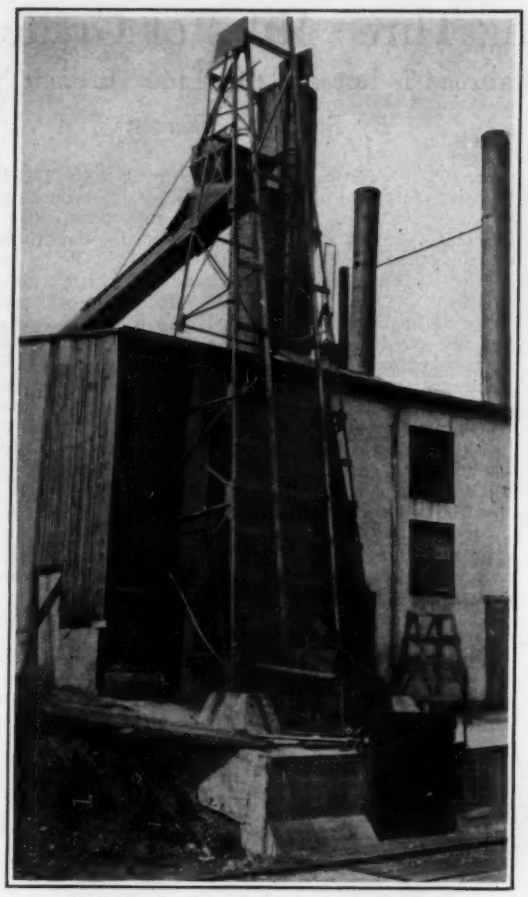
In Denmark, where the utilization of wind-power was greatly stimulated during the World War, and where all other countries are outstripped in the production of electricity from it, the favorite type of wind-wheel consists of five wings of the propeller-blade form, made of sheet-iron; each wing being turned, against the action of a spring, about its radial arm. All the wings can be turned "out of the wind" or "into the wind" at the same time. Particularly for starting this is a great advantage, as the starting effort can be increased by giving the wings only half a turn, leaving them in the position that corresponds to the low starting velocity of the wind-catch. In sudden gusts, or when the velocity of the wind passes the working maximum, the wings will turn automatically edgewise to the wind and be prevented from running too fast. The wind-wheels of all the Danish wind-motors

are evolved from the conventional airplane propeller.

The accompanying drawing shows a typical plan of Danish wind-electric plant delivering direct current. D is the generator driven by the windmill, M. The automatic regulator, R, will at any moment adjust the field of the generator to utilize to the utmost the energy of the wind. To a certain wind-velocity corresponds a rotation-velocity of the windmill; that is, the rotation-velocity of the mill is in proportion to both the wind-velocity and the R. P. M. of the generator. The output of the mill at any velocity of rotation is ascertained by direct measurements. Thus it is made possible to establish a definite relation between the exciter current of the generator and the current produced, the generator working parallel to a circuit, or battery of constant tension. Therefore, the regulator is so constructed that it keeps the generator and the mill at the rotation-velocity to get the most energy out of the wind blowing at a certain velocity. The automatic switch, S, is the circuit-breaker. This, as soon as the generator reaches the right tension, connects the generator with the circuit, and breaks the circuit again when the current from the generator drops to zero on account of the wind's falling below the working minimum. The generator and battery are provided with the necessary fuses, switches, meters, and other accessories. If the plant must work for long periods without supervision, the battery switch may be operated automatically; otherwise by hand.

Unlike these Danish types, the several types of French wind-motors are evolved from the hydraulic turbine, which has been adapted to a different medium. The most efficient French type, instead of being a disk-shaped wing-wheel with a vane to keep the disk facing the wind, like the ordinary windmill, is not a disk and needs no vane. On the whole it is cylindrical in shape and consists of a fixed outer part and an interior assemblage that is movable. The fixed part is designed to catch the wind, just as the radial gates of the hydraulic turbine conduct the water to the movable spokes. It is formed of iron slats inclined at 40 degrees, and disposed at equal intervals around a cylindrical drum. It is as little as if one rolled Venetian window-shades into the shape of a cylinder. This form causes orientation of the wind, which finds a series of slats between which it is caught. This does away with the need of a vane or other system of orientation. To hold the slats in place two rings are used, which form the bases of the cylinder and to which the slats are bolted. The rings are pierced to let the wind escape after actuating the movable part, which turns easily on ball-bearings at its center axis. The movable spokes follow a spiral curve like that used in the construction of hydraulic turbines.

It is noteworthy that the gate-openings between the slats are invariable, so that the turbine is capable of catching only so much wind at a time. This makes this French wind-turbine highly applicable to the prairie States where terrific winds are frequent; because, as the wind-pressure continues to increase it cannot accelerate the turbine beyond a certain rate of speed. The ball-bearings on the central axis respond easily to the pressure of very slight winds. By increasing the diameter and height of the cylinder, or better, by installing a turbine of several stories, with the same central shaft, 300 horsepower or more are obtainable.



Upright track on which a dump car runs

A Vertical Dump Line

AMONG unusual mechanical arrangements, a place near the head of the line should by all means go to the dumping car illustrated immediately above, which operates on a vertical track instead of the horizontal or inclined one that is so much more conventional. The bottom of the track runs down into a subway-like pit. In this pit the dump car gets its load; and when full it is rolled to the foot of the upright track, where it begins its upward ascent. At the top the load is dumped to a specially constructed chute.

Solar Cooking with the Aid of Oil

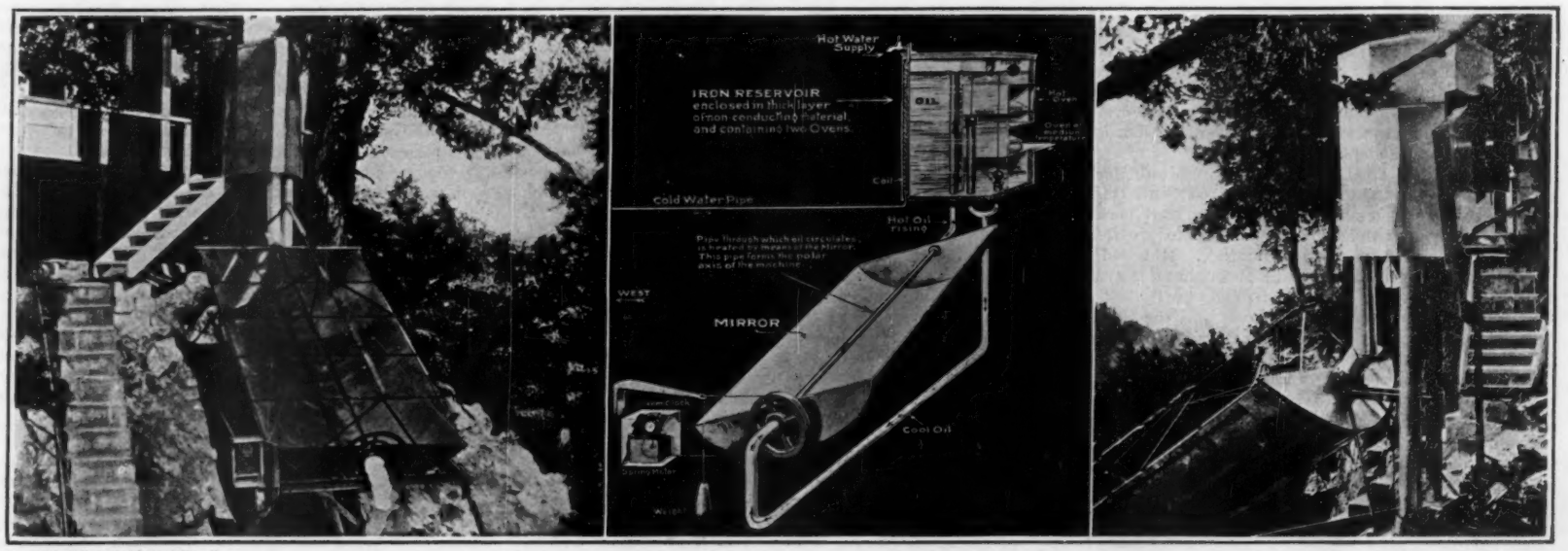
SO much interest has been excited in the Mount Wilson solar heater that the description prepared by Mr. C. G. Abbott, of the Smithsonian Institution, the chief experimenter, has been seized upon by various foreign publications; and we are actually able to borrow the pictures herewith from our British contemporary, the *Illustrated London News*. The experiments were originally undertaken in 1916, but were interrupted by the war and resumed only in 1920. The mirrors were sheets of polished aluminum, rolled into parabolic form four years previously to the 1920 resumption of work. Very considerable losses of heat were incurred through the impossibility of keeping absolutely clean the glass housing of the mirror and of the oil tube; by the failure of the home-made driving motor to adjust the mirror for the motion of the sun in declination; and by the unavoidable shading of the apparatus by trees that could not well be removed. In spite of all this, all varieties of baking were successfully done, though requiring a longer time than ordinarily because of the lower oven temperature. Cooking of meats and vegetables was exceedingly satisfactory. Breakfast cooking of cereals, etc., was altogether simple.

The reservoir is filled with gas-engine cylinder oil of high boiling point, and has three 2¼-inch pipes leading to it from the top, the middle, and the bottom respectively. The top pipe is bent down to enter the upper end of the mirror, and the middle and lower pipes, joining at the outside of the bottom of the reservoir, lead down underneath the mirror and come in at its lower end. Within the mirror frame in the mirror focus, parallel to the earth's axis, is a straight pipe which completes the circulation.

All parts of the oil circulation outside the mirror are wrapped with a thick layer of non-conducting material, mainly cotton, and the mirror itself is covered on the back with layers of cotton and galvanized iron. The top of the mirror is covered with sheets of glass to prevent the wind and the dust from coming in, and the tube which lies in the focus of the mirror is cased with glass so as to cut off convection currents.

The reader will at once understand the principle of the device, for it is the same as that which is in common use in cooking-stoves and furnaces to provide hot water for domestic purposes. In other words, the heat which is absorbed within the mirror expands the oil in the tube and tends to make it rise, so that the hot oil is continually entering at the top of the reservoir, and the cooler oil flowing from the bottom.

Another feature is introduced to take into consideration the different temperatures required for different kinds of cooking, and to take account also of the cooling of the oil which occurs when the sun is obscured by clouds or at night. A valve is provided within the reservoir, so that the circulation may take place either through the tube at the middle of the reservoir or through the tube at the bottom of the reservoir, as desired. An automatic control for this valve is provided by means of a float, so that during the first part of the heating of the reservoir the circulation takes place through the pipe at the middle, leaving the lower part of the oil unaffected; but when a certain temperature is reached the oil in the reservoir, having expanded, raises the float and changes the valves, thus causing the circulation to flow from the lower tube. The effect of this is to concentrate the heat in the upper part of the reservoir when the latter is too cool, and to extend automatically the volume of heating after the upper part has become sufficiently hot. The further effect of it is to cause the upper oven to be the hotter, and the lower of a medium temperature. Provision is also made for cutting off the circulation entirely at night, so as to prevent the apparatus from reversing itself by diffusion.



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Left: The Mount Wilson solar cooker, showing the mirror and the arrangement of oil pipes. *Center:* The details of the apparatus. *Right:* The hot-oil reservoir and the ovens

Cooking with oil heated by the sun's rays reflected from a mirror

Eliminating Three Miles of Grade Crossings

How the Lackawanna Railroad Is Recasting Its Line Through Newark and the Oranges

By Robert G. Skerrett

AT a cost of $4,000,000, tracks of the Delaware, Lackawanna and Western Railroad are being elevated for a distance of three miles to eliminate fourteen grade crossings and, incidentally, to increase traffic accommodations.

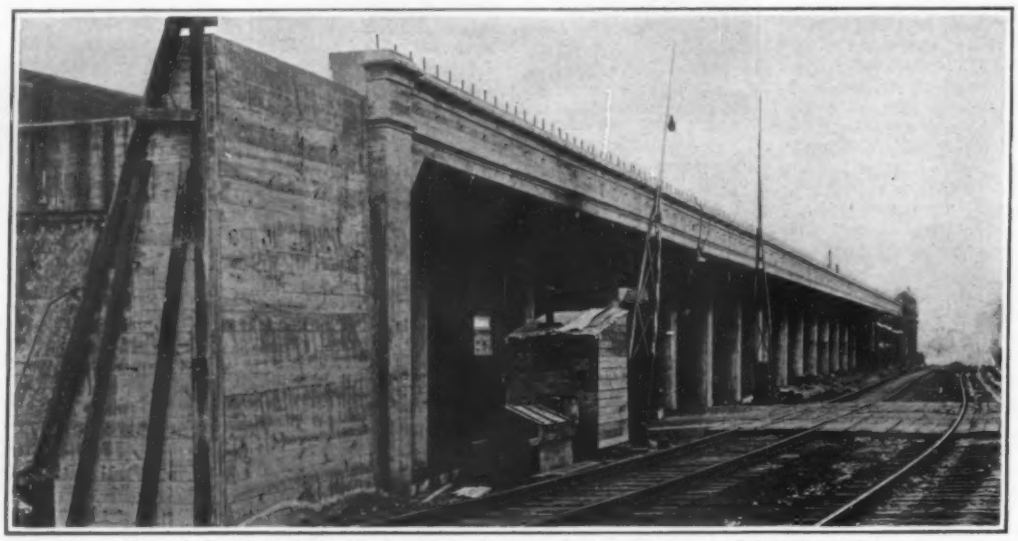
The tracks of this railway traverse a thickly-settled section of New Jersey immediately west of Newark, and for some miles the lines run athwart the thoroughfares of a seemingly single bustling community. The line, after crossing the Passaic River to enter Newark, runs almost due west across Newark, East Orange and Orange until its further progress is halted by the 500-foot ridge of the Watchung Mountains, so steep that even the automobile roads are carried up it with some difficulty; and, turning southward in search of a pass, the train traverses South Orange, Maplewood and Wyoming before finally reaching open country. The corporate limits of the municipalities mentioned merge directly into one another; there is absolutely no intervening open country to break the continuous miles of detached frame residences with occasional brick business blocks; and one unacquainted with the section would have no reason whatever for supposing that here, as in leaving New York to the north, one was not passing through the outlying residence section of a single immense metropolis. Over the two divisions of the system threading this region are moved daily, to and from New York City, many thousands of commuters. Not only are numerous trains operated to handle this traffic during rush hours, but there is a pretty full schedule of other suburban trains, together with distant expresses and a fairly steady tide of heavy freights.

East of Newark and west of Orange there are three tracks. Between Newark and Orange is a bottle-neck of two tracks, and time and again this arrangement has slowed down the movement of trains. This has been especially pronounced when the lines were working to capacity or when one of the two tracks was blocked for any reason. Where the roadways have bisected the streets at grade it has been necessary to maintain manually-controlled guard gates. Even so, accidents have occurred; and the growth of the communities and the increasing use of automotive vehicles have added greatly to the problem of public safety. The continuity of settlement is to be found along north-and-south as well as east-and-west lines of travel; from Elizabeth, Springfield and Millburn on the south to the outskirts of Nutley, Bloomfield and Montclair on the north the Jersey suburbs are in appearance one great community. An unavoidable result is an extremely heavy traffic on many of the streets that cross the Lackawanna, and a consequent magnification of the grade-crossing problem.

For a decade and more it was realized that the grade crossings ought to be eliminated; and this was emphasized by a common appreciation that both railroad and street traffic should be free to speed along without interference from one another. Material progress toward the desired change throughout the section under consideration was postponed until last year owing to the fact that the railroad and the interested municipalities could not agree upon a common plan. The railway engineers urged that the tracks be elevated; the civic officials vigorously advocated depressing them.

The scheme adopted early in 1921 was that offered by the railway technicists; and their preference for an elevated system was based upon ripe experience in the open cut, depressed portion of the road west of Newark and east of the present alterations and especially on that in a cut of several miles that features the branch line to Bloomfield and Montclair. As the railroad engineers have pointed out, an open-cut route is objectionable for several reasons. First, there is the continual flow of ground water downward from the higher surrounding land, which tends to saturate the soil and to increase the difficulties incident to keeping a roadbed in proper condition. In cold weather, this water, unless effectually drained away, is apt to invite the formation of troublesome ice; and, besides this, frost in moist ground causes more or less pronounced vertical displacements. Finally, snow falling in an open cut may seriously hamper traffic before it can be disposed of; and this removal is likely to be impeded by the need of plowing or brushing aside of the snow from one track and throwing it, pro tem, upon the other. The heaped-up track must then be cleared by the more tedious and expensive process of shoveling the snow into cars. Moreover, it is not too much of a look into the future to anticipate that some day this section of the line may be electrified. A third rail in a cut means that the power of the trains as well as their ability to progress is cut off in heavy storm or flood; and while overhead wires avoid this, it is bad practice to adopt a track design which leaves the electrical engineer no choice of means for the transportation of power.

The present improvements involve elevating the tracks on the Montclair branch of the line for a distance of a mile. In this run, the new structure will be well above three long-established grade crossings, and at a fourth point a new depressed crossing will be built to open a street previously blocked. On the main division, or Morristown section, eleven existing grade crossings are in process of being surmounted; and the elevated roadway will permit of the installation of a third or express track. This work embraces an interval of two miles; and will be merged at its western limits with the elevated tracks already in service from Orange onward.



One of the viaducts in the Oranges, showing the temporary tracks at the right

Of the two divisions concerned, the Morristown line is the more interesting, inasmuch as physical conditions there have laid a pretty heavy burden upon the resourcefulness of the engineers. This is especially true of the eastern half of the project where it is harder to raise the grade without interrupting service, because the temporary tracks must be held close to the old alinement. The tracks throughout the region affected are on a private right-of-way rather than a public street; the abutting property is very close to the tracks in many cases, and is often used for such purposes and in such ways that it is not possible to give the railroad the privilege of temporary use, while in other instances the topography is a similar bar. The western half has presented an easier problem, for there the engineers have had space enough to lay upon a paralleling street a temporary double-track line fully equipped with an automatic-block system. To the north of these tracks, substantially over the old line, are being reared the retaining walls and the viaducts which will carry the right of way on an average of 20 feet above the previous grades. This provision, in conjunction with depressing some of the under-passing streets from 3 to 10 feet, will insure clearances of from 13 to 14 feet for street traffic.

In climbing out of the cut west of Roseville Avenue, in Newark, the steepness of the grade is nearly doubled, the slope being 1½ per cent. This has been required to bring the elevated tracks to a proper altitude at East Orange station, where a number of busy thoroughfares are crossed. From there westward to Orange, the grades will be easy ones. Building operations were started on the first of April, 1921, and the engineers expect to have the job finished by the spring of 1923. The whole scheme, when completed, will represent a fine example of the use of concrete in the rapid execution of a big public improvement. Already the work has progressed to a point where the blockade imposed upon most of the north-and-south thoroughfares has been lifted, and traffic is passing through the new underpasses though still crossing at grade the temporary tracks on which the train service is still being conducted.

Generally speaking, the undertaking consists in the rearing of various sections of paralleling retaining walls, between which there will be dirt fills to support the tracks, and of intervening viaducts of reinforced concrete sustained by several lines of sturdy reinforced concrete columns. The two longest of these viaducts will be at stations, and they will have platforms of 800 feet and 110 feet in length, respectively, for the purpose of serving all three tracks.

The viaducts are of the so-called cantilever flat-slab type. The slabs are 20 feet deep in vertical cross-section. In addition to lateral and longitudinal reinforcing rods, the slabs, over each column, are strengthened by a mushroom or radiating arrangement of numerous steel rods so interlaced as to distribute the load and tie all of the columns and the slabs of any viaduct into a unified granolithic mass. The columns are reinforced with both spiral and straight steel rods; and the latter are hooked to the mushrooming slab-reinforcement. According to the lateral expanse of the slabs, the viaducts will be carried by four or five lines of columns. Abutments are also reinforced; but there is no metal in the retaining walls. The latter are of the simple gravity type, *i. e.*, composed alone of concrete.

Work has been accelerated on straight stretches of the retaining walls by pouring them in steel forms, but on the curves it has generally been necessary to employ wooden forms built to subscribe to the required arcs. Metal forms are used for the floors of the molds in which the slabs are cast in place, while wooden forms serve for the sides of the slabs and for both flanks of the surmounting parapets of the viaducts. All of the columns are molded in metal forms, which strip easily after the cement has set.

In a task of the present magnitude, and especially where the sustaining structures must meet the varying stresses of all kinds of trains running at widely different speeds, it is essential that the materials shall meet prescribed standards of excellence. All cement, aggregates, and steel must come up to specifications; and no cement is utilized until a sample of each lot has been tested. This is done by casting concrete cylinders, 12 inches long and 6 inches in diameter, which are sent to the railroad's laboratory at Scranton, Pa., where they are subjected to a crushing test.

Probably one of the most interesting angles of the work is the way in which the job has been pushed right on through the cold months. Freezing temperatures have not hampered progress; and this has been made possible by the adoption of certain precautionary measures. As is pretty well known by persons familiar with the art, warm concrete sets quicker and reaches faster a condition where it can withstand the weather. Therefore, the cement, the aggregate, and the water are heated to a temperature of from 60 to 70 degrees—steam coils being employed to effect this. As soon as slabs, for instance, are cast, they are covered with tarpaulins, and between these and the upper surface

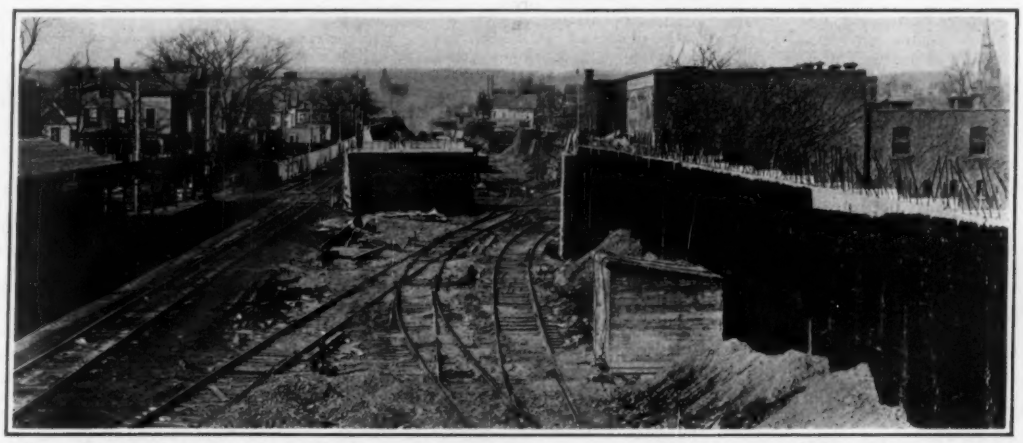
of the concrete are run lines of steam-filled pipes. Either a similar heating system or groups of salamanders are installed beneath the slabs; and the mass is thus kept warm until the concrete has dried out enough to be immune to the atmosphere. It takes from one to two months for the concrete to ripen and to attain its maximum strength.

The inner surfaces of all retaining walls, etc., are to be waterproofed. The nature of the waterproofing compound is not revealed, but it is said to represent the latest development in the art and to be of sufficient fluidity to be laid on by brush. In conclusion, the engineers of the railroad are profiting by the experience gained in kindred undertakings elsewhere in the Oranges and at Buffalo; and when the task is done the Delaware, Lackawanna and Western will be better circumstanced to deal with augmenting traffic demands and to operate at full speed without interfering with surface traffic. Only at the point mentioned west of Roseville Avenue has it been necessary to adopt a grade heavier than is commonly met on heavy-traffic steam lines; and this grade is considerably less than the one now existing up the hill out of the Newark station. The latter climb, incidentally, shares with the hills and curves of that section of the line passing through the Watchung Mountain, in and near Summit, the honor of having induced the railroad to construct the 30-mile Boonton Branch. This affords a loop leaving the main line outside of Hoboken and rejoining at Denville. As far as possible, through freight and passenger traffic has been routed over this line for many years; and it is used to give still further relief to the tracks through Newark and the Oranges during the present operations.

A street crossing on the Montclair Branch, showing elevation of the track and depression of the street grade

Mount Everest: The Reconnaissance of 1921

THIS volume on toplofty Mount Everest is perhaps the last of its kind, for what else is left to conquer? The North and South Poles have succumbed to the prowess of the explorers; and while there may be some odds and ends of rivers still remaining, a modern Robinson Crusoe would have a hard time in finding a desert island. In the rockbound ramparts of the Himalayas Nature has made her last stand—a stand that for the present is successful, since the attempt to reach the summit in 1922 has been definitely abandoned.



The partly finished retaining wall along the elevated section west of East Orange station. The new tracks will be laid on an earth fill between these walls

The story of last year's expedition, however, has arrived under the title "Mount Everest: The Reconnaissance of 1921," published here by Longmans, Green & Co. This is an account of the first great piece of exploration attempted since pre-war days. The book opens with an introduction by Sir Francis Younghusband, President of the Royal Geographical Society and Chairman of the Mount Everest Committee, by which the Expedition was organized. Then comes the narrative of the expedition itself, told by Col. Howard-Bury, the leader; he is followed by Mr. G. Leigh-Mallory who describes the strenuous climbing which, after many failures and disappointments, discovered what appeared to be a feasible route to the summit. Mr. A. F. Wollaston, another member of the expedition, deals with the remarkable fauna and flora of the Tibetan plateau and valleys, and the valuable survey work undertaken is summarized by Major O. E. Wheeler. The Geological results are dealt with by Dr. A. M. Heron. Especially interesting, is a chapter by Prof. Norman Collie, President of the Alpine Club, upon the difficulties of mountaineering at such unprecedented altitudes and the prospects of reaching the summit of Mount Everest in 1922. The illustrations, taken from the magnificent series of photographs brought back by the expedition, are visions of beauty and grandeur, and the maps display for the first time the topography and general features of a vast region hitherto unexplored.

Mount Everest for its size is a singularly shy and retiring mountain. It hides itself away behind other mountains. On the north side, in Tibet, it does indeed stand up proudly and alone, a true monarch among mountains. But it stands in a very sparsely inhabited part of Tibet, and very few people ever go to Tibet. From the Indian side only its tip appears among a mighty array of peaks which, being nearer, look higher. Consequently for a long time no one suspected Mount Everest of being the supreme mountain not only of the Himalayas but of the world. When Hooker was making his Himalayan journeys in 1849, Kanchenjunga was believed to be the highest.

Mount Everest was not always even known by name. In 1849, it was merely Peak XV. to the officers of the Great Trigonometrical Survey who were making observations from the plains of India to those peaks in Nepal which could be seen from there. Three years later the records yielded their big surprise. Heights were being calculated, and one day The Bengali Chief Computer rushed into the room of the Surveyor-General Sir Andrew Waugh, breathlessly exclaiming, "Sir, I have discovered the highest mountain in the world." The mean result of all the observations taken from the six stations from which Peak XV. had been observed came to 29,002 feet, and this Peak XV. is what is now known as Mount Everest.

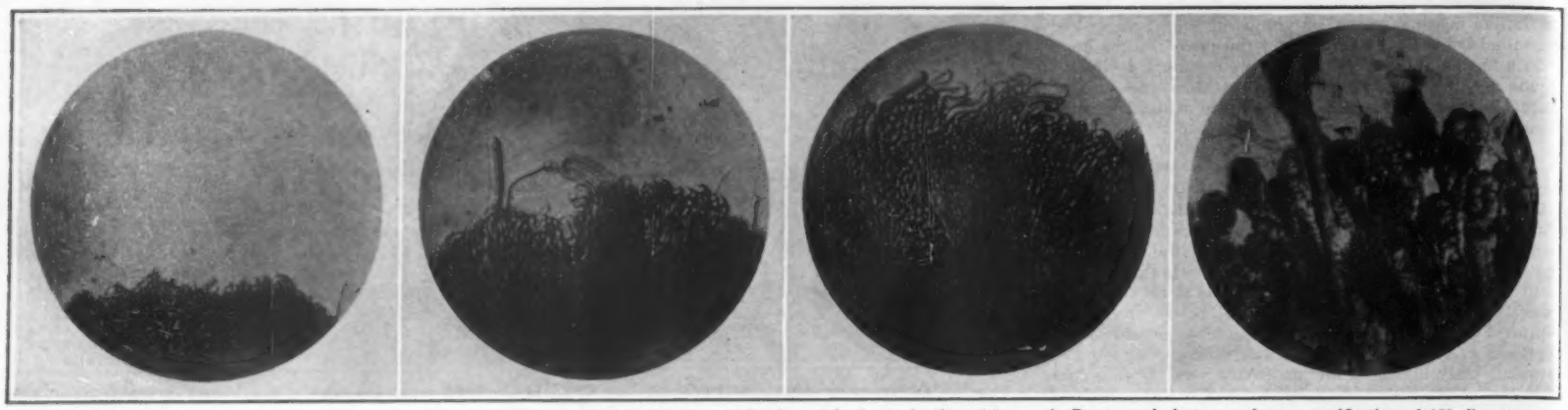
The question is often asked, "Why twenty-nine thousand and two? Why be so particular about the two?" The answer is that that particular figure is the mean of many observations. But it is not infallible. It is indeed in all probability below rather than above the mark, and a later computation of the observed results puts the height at 29,141 feet.

Sir Francis Younghusband, President of the Royal Geographical Society says: "The climbers are unwittingly carrying out an experiment of momentous consequence to mankind. They are testing the capacity of the human race to stand the highest altitudes on this earth which is its home. No scientific man, no physiologist or physician, can say for certain whether or not a human body can reach a height of 29,000 feet above the sea. We know that in an airplane he can be carried up to a much greater height. But we do not know whether he can climb on his own feet such an altitude. Conway reached 23,000 feet; Kellas, 23,186 feet; Longstaff, 23,360 feet; Dr. Workman, 23,000 feet; Kellas and Meade, 23,600 feet; the Duke d'Abruzzi, 24,600 feet.

Suppose men do reach the top of Mount Everest, what then? Suppose we do establish the fact that man has the capacity to surmount the highest summit of his surroundings, of what good is that knowledge? This is the kind of question promoters of the enterprise continually have to answer. The reply on sentimental grounds is one which a person who asks this question is apt to reject. So we may quote Sir Francis in his effort to show that direct practical results flow from the increasing confidence which man is acquiring in face of the mountains.

"A century ago Napoleon's crossing of the Alps was thought an astounding feat. During the last thirty years troops—and Indian troops—have been moved about the Himalayas in all seasons and crossed passes over 15,000 feet above sea level in the depth of winter. On the Gilgit frontier, in Chitral, and in Tibet, neither cold nor snow nor wind stopped them. In winter or in summer, in spring or in autumn, they have faced the Himalayan passes. And they have been able to negotiate them successfully because of their increased knowledge of men's capacities and of the way to overcome difficulties that constant wrestling with mountains in all parts of the world during the last half-century has given."

Coming up the grade at Grove Street, where it was necessary to elevate the tracks on the established line without interrupting service. There was little space at the sides for temporary tracks over much of this stretch



1—Just beginning to grow after 30 minutes. 2—After two hours. 3—Well-developed crystals after eight hours in the mixture. 4—Pronounced clusters under a magnification of 150 diameters

Several stages of the liquid crystals of lecithin in a bath of glycerine and water. In all these views save the last the magnification is 50 diameters

Crystals that Live

By Dr. E. Bade

CRYSTALLINE substances are generally conceded to be solid and massive, either having developed distinct crystals having an internal structure such that, under more favorable conditions, definite crystals would have been formed. But such substances need not necessarily have definite and uniform shapes. There has lately been developed a class of chemical compounds, for the greater part of an organic nature, which develop *liquid* crystals. These, instead of having uniform and constant faces, change their shape according to prevailing conditions. They are able to "flow" around corners, grow to a certain size, and divide or split into smaller crystals. But here the internal axis of the liquid crystal is just as constant as that in the solid crystals.

Liquid crystals are difficult to make and they generally require elaborate apparatus for observation, but with distorted liquid crystals or liquid crystalline substances no such difficulty is to be found. These, instead of having definite geometrical forms, produce peculiar growths which are readily observable under a magnification of about 100 diameters. These are termed "myelin forms," although this word has no definite chemical meaning.

Cholesterol, cholesterin, or choline compounds exhibit this peculiar physical phenomenon. These are substances found in all forms of the protoplasm, being especially abundant constituents of nervous tissues. When occurring in excess in the bile, they form concretions known as gallstones. They are also among the important constituents of the brain, where they are found in a free state. They also occur in the seeds of many plants and can be prepared synthetically by the action of trimethylamine on a strong solution of ethyl oxide.

Not only are these substances a waste product of the body's metabolism, but they exert an important protective influence against the entrance of poisonous toxins. The presence of cholesterol in the envelope of the red blood corpuscles hinders the solvent action of one of the poisons found in cobra venom.

A cholesterol compound forming a curious complex with glycerin, phosphoric acid and fatty acid is known as lecithin. It is found in the yolk of eggs from which it can easily be extracted as a soft waxy substance which is well adapted for microscopic examination. It is one of the many compounds exhibiting liquid crystalline structure and "myelin formation."

It is prepared from a hard-boiled egg. Place the yolk in a glass beaker, add 1½ ounces of ether and grind it up thoroughly. Filter the mixture through a paper filter. Pour through the residue remaining in the filter two drams of ether. Let it drain. Then pour through two drams more and unite the filtrates and discard the residue.

Evaporate the ether extracts very carefully on a steam bath. Great care must be taken with the ether, since it is very inflammable; it should never be placed over or near an open flame. When the ether has evaporated add two drams of alcohol and heat gently to boiling. Pour the hot alcohol through a small filter, being careful to *leave the heavy oil in the beaker.* Repeat this operation with two more drams of alcohol and unite with the first alcoholic filtrate. Discard the precipitate in the filter. Evaporate the alcohol on a steam bath. Don't be discouraged if there is only a comparatively small residue.

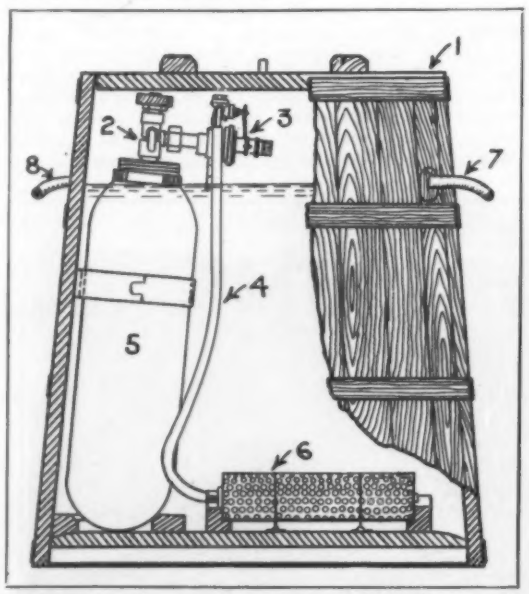
Dissolve the residue from the alcoholic extract in two drams of cold ether and then add four drams of acetone. Stir continuously until the particles of lecithin, which were precipitated by the acetone, unite to form a ball. If the ball is slow in forming, add a few drops more of acetone, but not too much. The resulting ball is reddish yellow and tastes and smells like an egg.

When a tiny fragment of this waxy substance is placed upon the slide of the microscope, and is covered with a drop of water, threads will soon be observed shooting leisurely outward and twisting and turning into fantastic shapes, when observed under a magnification of 40 to 50 diameters. If they are observed under a power of 100 to 150 diameters, curious clusters and grape-like protuberances will quickly form together with tube-like structures which bend in all directions. If carefully observed, this action will begin whenever the water touches the material. Growth can be retarded if a few drops of glycerine are added to the water.

Safeguarding Live Fish in Transit

THE gourmet contends, and probably with reason, that a fish taken right from its native element and cooked promptly is more delicious than one kept fresh on ice. Be this as it may, it is a fact that there are many people that prefer to buy their fish alive, still capable of wriggling vigorously. Such is the case in Germany, for instance, where dealers have for years made it a practice to cater to the trade by displaying their finny wares swimming about in tanks.

To satisfy this particular demand for aquatic foodstuffs, the Teutons have devised various sorts of containers which make it feasible to transport the commodities considerable distances, for it must be borne in mind that the sources of supply are often remote from the points of consumption. However, without going into details, these tanks, tubs, etc., have sometimes failed to deliver their contents unharmed; and the percentage of dead fish has frequently been high when the journey has been unduly long. Again, the loss has been marked whenever there was a sudden rise in temperature; and it was realized that this mortality was not necessarily the consequence of water being too warm for the fish.



1—External wooden tank. 2—Supply-flask connection. 3—Adjustable oxygen valve. 4—Rubber tubing. 5—Steel flask of oxygen at high pressure. 6—Atomizing cylinder. 7—Tank-filling pipe. 8—Outlet for excess water

Diagram of the apparatus for transporting live fish

Scientific investigation has revealed that the fish actually died of suffocation induced by a deficiency of oxygen in the water. The amount of air which water will absorb from the atmosphere depends upon temperature and pressure; and, normally, water will take up air until it reaches a state of equilibrium or saturation. Under natural conditions, where the water is freely exposed to the atmosphere, there is an inherent tendency to maintain this equilibrium. On the other hand, if the water is in fairly deep tanks with a relatively moderate surface in contact with the atmosphere, the water may lose air faster than it absorbs it. This is especially true where the water in such containers carries fish which are continually withdrawing oxygen from it. Therefore, it is essential that artificial means be employed to revitalize the water by restoring to it enough oxygen to satisfy the physiological requirements of the fish.

A not unusual practice is to blow air at intervals into the water by the aid of an automobile tire pump or by dipping some of the water out of the tank and allowing it to drop back slowly—enabling it thus to pick up air in its descent. These procedures, of course, necessitate the presence of an attendant, and this is not always profitable or practicable where the fish are transported in freight cars and on long runs. Similarly, when the fish are held at market places for several days the water may become stale or deficient in oxygen unless steps are taken to aerate it. To meet these circumstances, and to insure the well-being of the fish the while, the Germans have recently devised an automatic apparatus capable of feeding constantly to the water the correct measure of replacement oxygen.

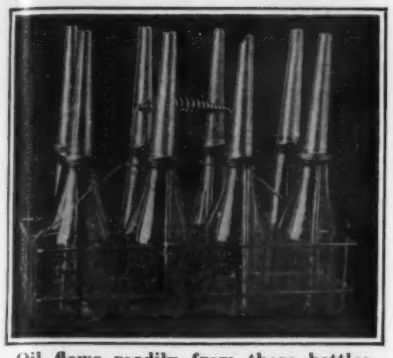
The equipment is made up of a steel flask charged with oxygen at high pressure, a reducing valve, a length of rubber tubing, and a sieve-like filter or cylinder. The latter is placed in the bottom of the "live box" or tank where it will break up the discharged oxygen into streams of minute bubbles so as to facilitate the distribution and the absorption of the gas. The steel flask may be secured either inside or outside of the tank. To the reducing valve is attached a cut-off which can be set to provide an hourly flow of oxygen agreeably to the needs of the fish in transit. That is to say, experiments have shown that the amount of oxygen to be supplied is governed by the total weight of the fish and the volume of water in which they are kept. Therefore, the valve can be adjusted to furnish 2, 4, 8, 15, 30 or more liters of oxygen per hour. Inasmuch as the oxygen flask carries enough gas to last for a considerable period, provision is made in this way for any delay in transit which may prolong the journey of the shipment.

The apparatus, while automatic in its operation, nevertheless calls for a measure of expertness or judgment on the part of those using it, because the fish may suffer harm if the water becomes super-saturated with the gas. In other words, the fish may experience a counterpart of the malady known among workers as caisson disease; and the excess of gas, if continued for but a few hours, may prove fatal. Carefully developed tables inform the shipper how to regulate the supply of oxygen to satisfy the vital demands of his consignment. It is reported that extensive employment of the equipment has amply demonstrated its commercial worth.

It should be self evident that an outfit of this nature would be of value in the distribution of live fish or spawn for any purpose, and especially where they must be moved afar and, therefore, be in transit for days. Further, it is not unlikely that apparatus of this character would be of service to some aquariums and experimental stations.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



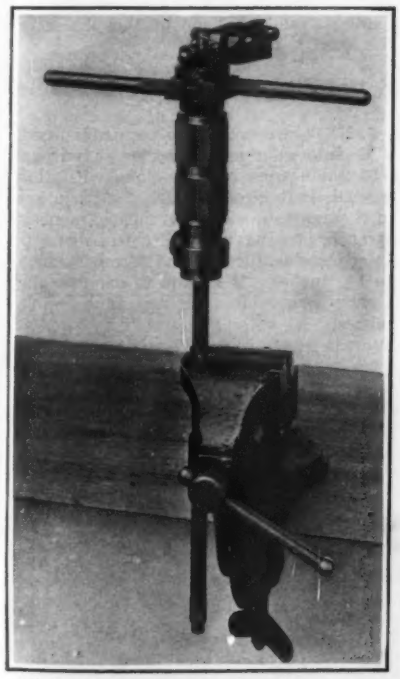
Oil flows readily from these bottles, with their breather pipes

Another Way to Sell Oil

THE measure-and-funnel method of filling oil into the crank-case of the waiting automobile is slow and dirty, and often results in a waste of oil. But one garage owner has hit upon a novel scheme for avoiding all this. He has a number of glass bottles, each holding a quart of oil; and each has a breather pipe extending from its mouth, down to the bottom of the bottle, on the inside. This brings the atmospheric pressure to the aid of one who attempts to pour oil from the bottle, and results in a rapid flow in place of the more usual trickling gurgle.

Machine Work without a Machine

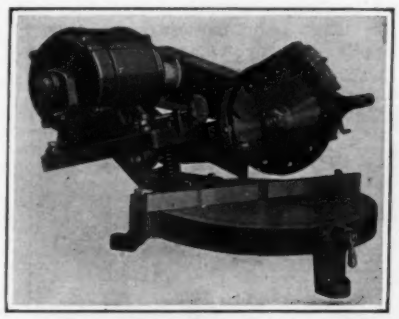
FROM Worcester, Mass., there comes upon the market a "hand vise lathe," as the makers call it, of considerable interest. This tool enables one, without the use of an engine lathe or automatic screw machine, to make from bar stock anything in the way of a milled stud, set-screw, cap-screw, pin, etc., to say nothing of many special screws and studs used in automotive and other machinery. With it also wire springs can be wound to any desired pitch.



With this hand-tool and a vise, screws and studs of all sorts are made and springs wound to any desired pitch

The combined die and tool holder seems to be the paramount feature of the new tool. This holder is so constructed that the required die may be fitted in its upper portion, and a centering bushing of the correct size in its lower portion. The distance between the center of the die and the center of this bushing is nine-sixteenths inch, thus giving a long bearing for the stock to be threaded. This stock passes first through the centering bushing, before being engaged by the die; hence it is not possible to cut the thread off center. The device is hand fed, allowing the operator to take a fine or a heavy chip, as occasion demands.

We show the hand vise lathe set up and cutting a chip from a bar held in a vise. The lower end of this bar shows where a shoulder has been milled down and the end knurled by the tool.



The graduated table of this portable saw is designed with special reference to the cutting of mitres

Portable Saw for Cutting Miters

A PORTABLE saw recently developed by a Michigan manufacturer has a circular table graduated both ways from zero to forty-five degrees and the saw swings with this table. At the front edge of the stationary table a locking pin engages with slots in the outer circumference of the revolving table, and this makes it possible to lock the saw at any desired angle.

Both the motor and saw are mounted on a tilting frame and belted together. In turn, this frame mounts upon the swiveling platform. When not in use the saw is kept in a raised position by a flexible spring, and it also furnishes the necessary resistance for accurate work. At the axis of rotation a stationary gage is located. On the handle-piece a snap switch is used for starting and stopping the motor.

The hand casting is designed so as to cover the saw edge except at the cutting point, and here a double guard protects the teeth on both sides. If accidentally depressed this guard locks securely so that the saw cannot do any damage. Before making each cut the guard is unlatched with the right forefinger. A full-length outside guard protects the belt and pulleys. At the rear of the saw a spout carries off the sawdust, so that it is not thrown in the operator's face.

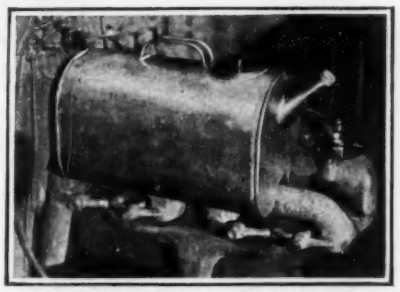
A Compact Magnet-Tester

THE inability to magnetize properly a magnet shows that the steel is of inferior quality and unfit for use. A weak magnet detracts from the strength of stronger magnets near it and proves a source of weakness in two ways. This instrument, developed by a Chicago manufacturer, indicates in a positive manner the exact magnetic strength of a magnet. The scale is graduated from 0 to 100. A fully charged magnet will read 85, and this is its maximum capacity. In order that a magneto be at its highest rate of efficiency its magnets should be charged to indicate from 70 to 85.

The moving parts of the instrument are enclosed in a wooden case and the scale is shown behind a glass window on the top. Magnetic lines of force are carried into the interior of the instrument by means of a steel contact shoe at the back and lower edge of the instrument. When the pole of a magnet is applied to this shoe, the pointer of the tester moves over the scale and comes to rest at a point indicating the relative strength of the magnet. Each pole of a magnet will indicate the same on the instrument, and either pole may be applied.

Hot Coffee from the Automobile Exhaust

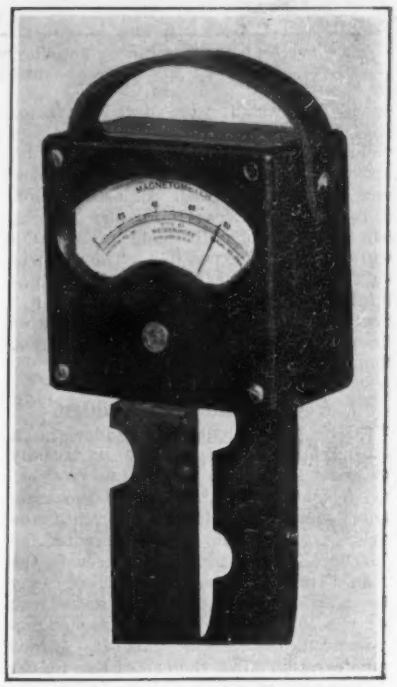
THE summer tourist who is condemned to ride in the front seat with the driver will give willing testimony to the effect that there is superfluous heat generated by the automobile sufficient to heat the coffee, and have some left over. But it isn't easy to remove this heat from the space around the driver's feet, and localize it in the coffee. But with the aid of the device pictured herewith this can be done nicely enough. The coffee pot is saddle-shaped, and sits snugly over the exhaust manifold; and we may be sure that the coffee is not long in heating, in this advantageous station.



The heat from the exhaust provides the means of operating this coffee pot

Grinding Pulleys with Their Own Power

AMONG the applications which have been found for that useful process, grinding, few are of more importance than the resurfacing of large wheels, pulleys, etc. And for this work a new grinder has just been put out which has the rather important feature of using no independent power. Its abrasive wheel is driven wholly by frictional contact between the arbor and the surface of the wheel being ground. When in action the grinding surface of the cup-shaped abrasive wheel travels at approximately one-half the speed of the ground-wheel surface. This sheer angular cut, combined with the difference in speed between grinding and ground surfaces, sets up an abrasive action which the makers of the device claim to be extraordinary. When taking a normal cut, the abrasive wheel is fed across the face of the big wheel at three to four inches per minute. The arbor is adjusted in angular relation with the driving wheel that is to be ground, so as to obtain the desired speed differential between grinding and ground surfaces.

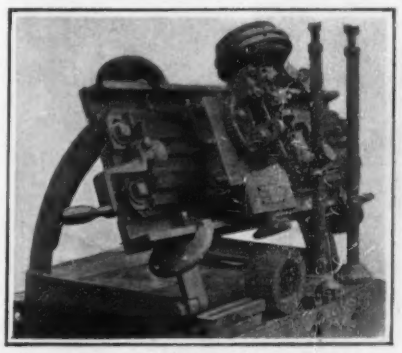


Magnet tester of unusual utility

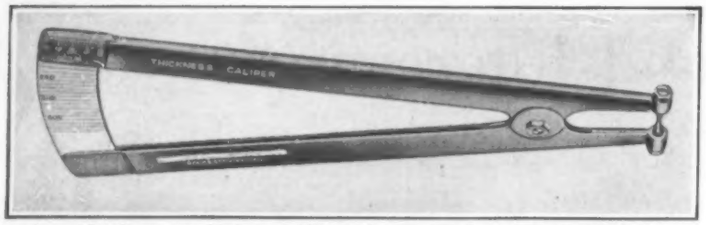
A One-Hand Calipers

A NEW YORK manufacturer has introduced a caliper for quickly and accurately measuring the diameter or thickness of objects up to nearly one-half inch. The scale on one side reads to 1/1000 inch and that on the other to 1/64 inch. It is claimed that its shear design makes it useful for getting measurements in many places where the use of a larger instrument would be awkward or utterly impossible. Since it requires the use of only one hand in operation, it will be found particularly useful in work where the extreme exactness of a micrometer is not required.

The scale is made of German silver so as to eliminate the possibility of rusting. Graduations on one side indicate 1/50 inch, while the vernier has 1/20th inch graduations so as to make possible correct readings up to 1/1000th inch. The ends of the measuring points are rounded in spherical form, in order to



Ingenious grinder for the faces of large wheels and pulleys



A novel calipers combining rapidity and accuracy for measurements up to one-half inch

avoid false reading on curved surfaces. If it is ever necessary to adjust these points in case of wear, they can be moved by a screw-driver after the lock nut has been loosened. In construction this caliper differs from other models, so that a longer life and greater accuracy are made possible. The U form of frame gives greater strength and stability than can be obtained with flat metal, and the large bearing surface of bronze eliminates excessive wear at that important point.

A One-Man Fire-Ladder

THE conventional fire-ladder is a mighty unwieldy affair. It usually requires six men to hoist it into position, with considerable bustling and bossing and some profanity to lubricate the wheels. With the ladder invented by Herbert J. Hopkins, an engineer in the San Francisco department, wheels may be mentioned without using any figure of speech, but the necessity for extemporaneous lubrication vanishes. As our photograph shows, the end of this ladder is mounted on a pair of light automobile wheels, so that guidance rather than raising by brute force is what it requires. In spite of the fact that its transport requires a trailer, it will be evident that the new style of ladder does not clog the streets or side-swipe the sidewalks any more than the old; for the over-all length of car and trailer is no greater than that of the old-fashioned ladder-truck, and the general maneuverability is considerably greater.

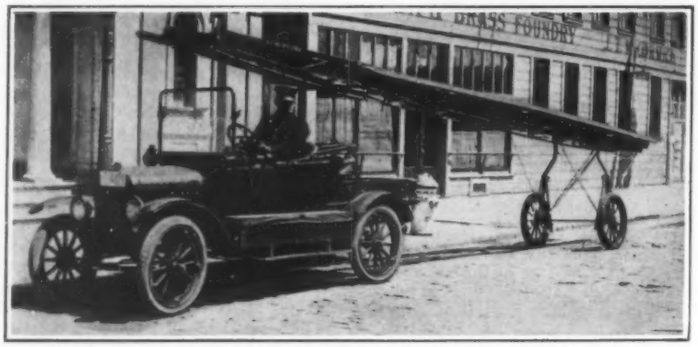
Holding Up the Saxophone

PLAYING the saxophone is far from being the easiest job in the world, or even the easiest job in the orchestra. The best part of the saxophone artist's efforts, however, so far as mere physical exertion is concerned, is devoted to the support of his instrument. Now a saxophone holder has been put on the market which will attend to this detail for him. It takes the weight of the big horn, yet leaves perfect freedom of action for the player. It can be adjusted to any desired position and is readily moved. The holder, of metal tubing, is extremely light; and it has noiseless ball-bearing casters and a swivel base. It is manufactured for all sizes of instrument. The makers suggest that it will be of value, not alone to the musician, but also to the dealer for the display of saxophones in window, wall-case and on the floor.

Taking the discomfort out of saxophone playing with a stand for the big horn

Magnet Recharging Made Easy

A SIMPLE method for recharging magneto magnets—so simple that anyone can use it—was recently discovered by a mechanic of considerable local reputation, and reported to the motoring fraternity by *Motor Life*. His system is to rotate the armature at very high speed for a few minutes. To do that it is necessary to remove the magnets from the engine, but it is not necessary to disassemble the magneto. The high rotational speed demanded can be obtained by jacking up some other car so that one rear wheel is driven free by the engine. The edge of the magneto coupling is held against the side wall of the spinning tire for a time, when it will be found that the magnets have taken a new charge. It is difficult to explain why this action takes place but evidently the high rotational speed of the armature must in some way set up a strong magnetic field which reacts on the magnets.



A ladder that travels to the fire and goes into working position with unaccustomed ease

An Electric Sealing Machine

IN accordance with present-day ideas of efficiency and safety, an electrically operated sealing-wax machine, made of heavy pressed steel, nickel-plated, and constructed to meeting the requirements of bankers, brokers, jewelers and large commercial institutions for sealing valuables, has just been invented and placed on the market. Burnt hands and fire hazard through the old method of sealing prompted the invention of this device. Not only does the machine, shown herewith, eliminate the danger of fire and burnt hands, but it effects a saving of 50 per cent in sealing wax, 50 per cent in time, and 20 per cent of postage through the saving of wax.

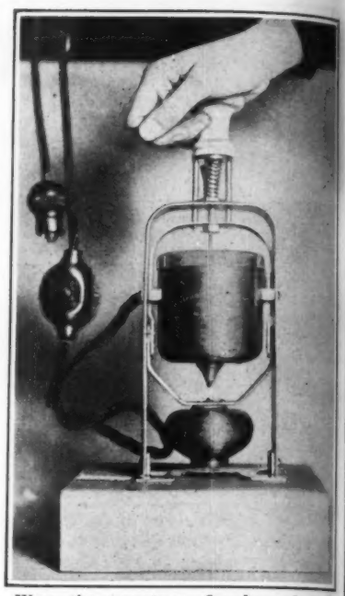
The machine works on the same principle as a numbering machine. It is capable of sealing ten letters or packages in one minute and costs one-half cent per hour to operate.

The sealing wax is placed in an aluminum pot, which is detachable, and, to retain the heat of the wax, fits inside of a brass pot. The inside pot holds enough wax for more than 200 seals, and can be refilled at will. The heating coil is attached to the heating pots and the heat is controlled by a three-heat switch. When full heat is turned on, three minutes are required to melt the wax, but when the latter is melted, a low heat keeps the wax at required temperature. The heating element is non-metallic and practically indestructible and works on direct or alternating current.

A private steel die is attached to the base of the stamping knob at the bottom of the device. Only two movements are required to make the seal. The wax is released by pressing the lever toward the handle. A small quantity of wax falls on the material which is to be stamped. The swinging knob holding the steel die is brought into position and makes the imprint clearly, by pressing the handle at the top, in the same manner as a numbering machine.

Standardizing Body Nomenclature

THE Society of Automotive Engineers is about to attempt to straighten out the language of motoring so far as it applies to body nomenclature. It says that a survey of advertising matter issued by different automobile companies shows various names are used to designate bodies which are practically identical, all of which is confusing to prospective purchasers and owners. This confusion has in part been caused by trying to adapt several of the old carriage names to passenger cars and by the coining of body names for commercial motives. A report just submitted by an S.A.E. committee recommends fundamental body types as follows: Roadster, touring, sedan, berline, coupe, coupelet, limousine, brougham, limousine-landaulet, cabriolet and town car. The last named term really is a more general term for certain of the chauffeur-driven types.



Wax, time, postage, fire hazard and scorched fingers are among the things saved by this electric sealer

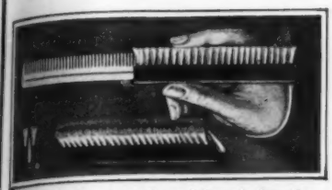
New Aluminum Piston Design

THERE is much evidence that the aluminum piston is in a new period of development. The objectionable features of the earlier designs are now fully understood by engineers. In a new piston, the skirt is partly detached from the ring belt and the lands between the ring grooves are turned with sufficient clearance so there can be no trouble from seizing. Only the skirt is depended on for bearing surface. Those portions of the skirt around the ends of the piston bosses are relieved and are partly detached from the rest of the piston by saw slots. The bosses connect the piston head and the ring belt by two substantial ribs running parallel with the piston pin axis. The skirt is split on the pressure sides by inclined saw slots, but round bosses are cast on the inside of the skirt where these slots come and these are later drilled out and form a springy connection across the slot. The only connection between the skirt and the ring belt is furnished by four shallow ribs extending from the head of the piston to the skirt.

Set of Socket Wrenches in Single Tool

A NEW wrench combines in its usefulness a set of socket wrenches. The same work can be done with this wrench that is accomplished with a set of S wrenches, socket wrenches, monkey wrench, pipe wrench and a tire tool. It is adjustable for any unit from ⅛ inch to 1⅜ inches. It is said to get into the tight corner and other inaccessible places. It weighs 1½ pounds, with a 10-inch length and a 3-inch head.

An adjustable wrench of a new type that takes the place of a whole set of socket wrenches



A combination comb-and-brush for the vest pocket

A Vest-Pocket Toilette

A COMBINED pocket brush and comb is now offered which can be carried in a gentleman's vest pocket (as it is no wider than a fountain pen) or lady's hand bag. The brush has preferably two rows of strong bristles between which the comb can slide back and forth. The comb can be drawn out for use of either in due order, or they can be closed together for use in combination, when the two can work in unison.

Cleaning Switches by Compressed Air

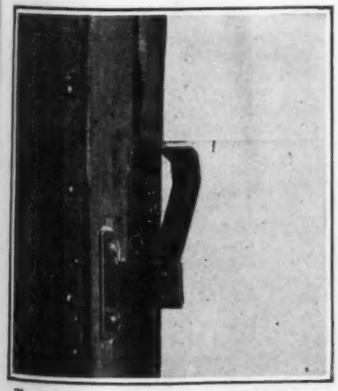
THE accompanying photograph shows the method employed by the Southern Pacific railway for cleaning dust and dirt from the switches and frogs from between the rails by means of compressed air. The switches on this division are operated by electric-pneumatic control. At each switch a connection is arranged so that a pipe can be quickly connected to the compressed air line. By means of a hose and a two-foot pipe a blast of compressed air is directed into the switch-box, which blows the dirt and dust out quickly and easily. The same is the case with the frogs and between the rails.

After the dust and dirt have been completely removed from the switch-operating mechanism in the switch box, oil is applied to the mechanism, and a stream of compressed air directed against same, which blows off the oil, thoroughly cleaning the mechanism.

For Rattle-less Windows

THE closed automobile has its many advantages, which its increasing popularity makes manifest; but it has one annoying possibility that can never exist in the open car. License plates, springs, radius rods, hoods, and a thousand and one other things will rattle on any car, if they are not tight; but the only car that can rattle its windows is the car that has windows to rattle.

Harry E. Ewing, of Smithfield, Pa., has recently patented a little anti-rattler which he is confident will silence the most stubborn window. It consists of a base plate that screws to the window frame, and carries a rectangularly projecting socket for the end of a steel strip spring. This spring is lined with felt, and while one of its ends is securely established in the holder the other presses firmly against the glass panel. The spring member is offset from the base sufficiently to allow its use on windows provided with weather strips or packing at their edges. It will be manufactured in rights and lefts, and if one of them will not hold the glass steady several will surely do the trick, according to the inventor. It is possible to raise and lower the glass while the spring is in action, but it will not vibrate laterally. While designed primarily for automobiles, it can obviously be used for windows in houses and other locations.



To take the rattle out of closed-car windows

Small Car Popular in England

THE small car bids fair to remain popular in England for at least another year, although a stabilization of industrial conditions will likely bring about a demand for heavier cars. The *Manchester Guardian*, in discussing the subject says the small car, in addition to its relative cheapness, has been found entirely satisfactory to owners. They point to the fact that motoring has become a business and unless the business depression is removed it is unlikely that buyers will want to sink large sums in more expensive machines. A number of these light cars weigh, complete for the road, about 1200 pounds and are equipped with two-cylinder air-cooled engines similar to those employed on motorcycles, these rating at 6 to 8 horsepower and running as high as 50 miles per gallon of fuel. Perhaps nothing will so clearly indicate the character of these cars as the statement that, in most road events organized for "light cars," the tin lizzie which we in America regard as the light car *par excellence* is barred; it is not a light car within the intent of the contest.

Vacuum Chamber in Piston a New Idea

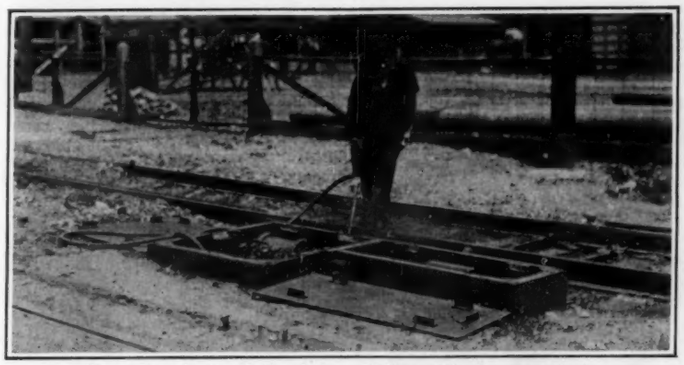
A NOVEL design of internal combustion engine piston, embodying features intended primarily to prevent the burning of the crankcase oil as it comes in contact with the lower side of the piston head, is being exploited. A pressed-steel, air-tight chamber from which some of the air has been exhausted is chill-cast into the upper part of the piston directly underneath the head. After the air chamber is in place in the piston a small hole is punched through the center of the lower face, some of the air is then forced out from the chamber by heating, and the punch hole is sealed up by soldering. In this manner a vacuum of about 8 in. mercury is obtained in the chamber. It is claimed that the use of this "vacuum" chamber prevents the "coking" of the oil on the piston and that no gritty matter can be found in the crankcase oil of an engine equipped with these pistons after it has been in service for a long time. The crankcase oil, it is claimed, remains at a lower temperature than in an engine with ordinary pistons.

The Easy-Reading Gage-Glass

THERE has recently been developed a novel background for boiler gage glasses that has proved useful on heating and other small boilers where the pressure is low and where it is sometimes a question as to whether the glass is entirely full or entirely empty. The lines seen through the water in the glass are at right angles to those of the background, provided the latter is at the proper distance, and the lines through the empty section of the glass are about the same angle as those on the background.

In using this background to best advantage, it has been found that the illumination must be such that both the glass and the background will be thoroughly lighted, without any direct light coming into the eyes of the fireman who is trying to read the glass from the floor. Such illumination is best given by a well shaded lamp 12 feet or less from the floor, or, in case the walls of the fire room are painted white, by a skylight in the roof, during the day time. It is necessary for the fireman to get back away from the boiler so as to get some little angle of vision as he looks at the glass.

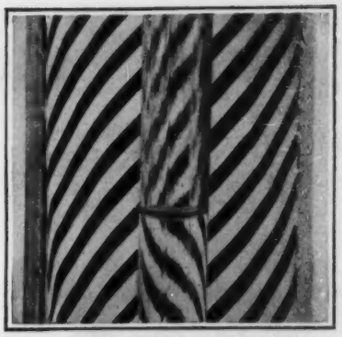
This scheme was first developed for use in the electric lamp works at Newark, N. J., where the interior of the fire room is white and where there is an overhead skylight.



Removing dust and dirt from switches with compressed air

Larger Tires Have Advantages

ONE of the unmistakable tendencies of the present moment in motordom is the drift toward larger tires. Within the recent months two leading makers have announced new models fitted with larger tires than the sizes previously used. Private motorists have already discovered the efficacy of this practice in the use of oversize tires and the fitting of larger tires as standard equipment by makers of two of the most popular cars in the country, indicates official sanction of the idea. The truth is that our ideas on tire service have undergone radical revision in the past few years. The coming of the cord tire has worked a revolution in our opinions regarding the real meaning of tire mileage. In the older days tires were a prime source of trouble while they lasted and the maximum mileage that we had a right to expect was three or four thousand miles. As the skill of the tire builders grew, the mileage that they managed to build into their products increased, until it was not uncommon to find fabric tires giving seven or eight thousand miles. Individual car owners long since discovered that by fitting their cars with over-size cords, they could not only get remarkably long service, but at the same time comfort in maximum degree. And now the manufacturers are acknowledging the justice of this stand by equipping their cars with larger tires to insure their patrons of tire comfort.



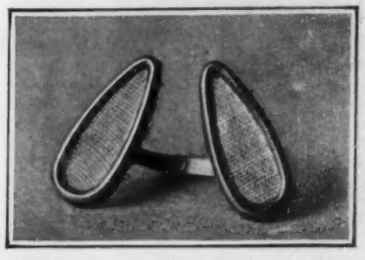
The refraction of the water reverses the stripes of the ground, and makes it plain where the top of the column of liquid stands

New Double Bevel-Gear Drive

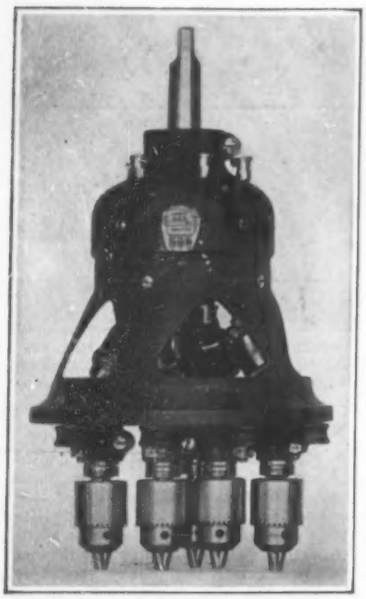
A RECENT development is a double helical bevel-gear for motor truck axles. The outstanding feature of this gearing is the double strength which is claimed to allow the use of very small bevel pinions so that it can give sufficient reduction and still have sufficient strength and road clearance for motor trucks, where it has heretofore been impossible to use bevel gears, and manufacturers have had to resort to the worm or double reduction gearing. Another advantage claimed by the designers, is a complete balance of all gear thrusts caused by the helical angle of all gears and also complete balance of the separation thrusts on the ring gears, allowing the use of cheaper bearings and a lighter case with at least as high efficiency as where only one set of helical bevels is used. The two ring gears and bevel pinions are interchangeable and the two spur gears are equal but of opposite inclination of the teeth. For trucks it is cheaper to make two helical bevel ring gears than one of the same strength, as the two and the elimination of gear thrusts allow the use of much cheaper bearings and case. It is claimed that the loss of power and extra wear from going through one more gear than the single-bevel axle is more than compensated for by the elimination of gear thrusts and the consequent lessened strain on case bearings.

The Nasal Filter

TO keep dust out of the nose and prevent injury to the sensitive mucous membranes of the nostrils and air passages, a nose and throat specialist, who made a long and careful study of hay fever and its causes, has devised an appliance known as the "nasal filter" which can be worn inside of the nose somewhat after the fashion in which eyeglasses are worn outside of it. It consists of two small oval frames of sterling silver covered with linen gauze and connected by a bridge of hardened silver wire. The linen gauze is held in place in the frame by a rim cap which snaps on to it after the fashion of a watch case, so that the linen can be removed at any time and a new piece



Filter, worn in the nostrils, to keep dust out of sensitive noses



Spindle-head of multiple drilling and tapping machine

fitted and trimmed off to size. The filter is grasped by the bridge and the points inserted first into the nostrils, the back part then being pushed up to the proper height. When in position the nasal filter fills the nostrils comfortably, only the tiny silver bridge showing round the partition of the nose. Being offset from the rims and circular in shape the bridge does not rub or press on the partition, and it may be lengthened or shortened by simply bending the wire to suit. Being of sterling silver the frame is sanitary and can be easily cleaned in hot or cold water, and the device is made in three sizes, large, medium, and small. In addition, if the wearer of the filter is afflicted with a cold in the head the cloth in the frames can be smeared, on retiring at night, with menthol, camphor, oil of pine tar, or other curative agent, and regular inhalations ensured in a manner not otherwise easily obtained. The appliance, although light, is strongly made and is claimed to stay in place very well.

A Revolving Nutmeg-Grater

THE latest nutmeg-grater is revolved instead of utilizing the old up-and-down movement for grating. The attachment on top is held down securely on the nutmeg, which will fit into the metal pocket provided. As the handle is turned it revolves the spice over the perforated surface.

A nutmeg grater that does not grind the user's fingers

Multiple Drilling and Tapping in Its Simplest Terms

WE illustrate the spindle-head of a new combination machine for multiple drilling and tapping. Each spindle is instantly converted, either for drilling or for tapping, without adding or removing any parts. When through drilling it is necessary only to remove the drill, insert the tap, release a set-screw, and the machine is ready for tapping.

Each spindle is a complete unit and may be used individually. The remaining spindles may be idle, or all may be operated together for multiple drilling and tapping. This is an especially valuable feature when it is desired to drill a group of holes, some but not all of which are then to be tapped.

A Machine for Rubbing Painted Surfaces

AN admirable illustration of the inventive skill and detail of design necessary in the conduct of a large manufacturing business is afforded by the body-rubbing machine invented by Spencer Brown, employed in a Syracuse automobile factory. It is designed to supplant hand-rubbing in paint shops. Operators using this machine have been able to maintain a regular schedule of rubbing out seven automobile bodies per day, double the work turned out by hand in the same time.

The machine has two feet, or kickers, working in opposite directions at each stroke, and uses compressed air as a propellant. Construction of the rubbing feet makes it possible to rub on uneven or rounded surfaces as well as on a plane. The frame and all possible parts are of aluminum, with the result that the weight of the machine totals only 20 pounds. It can be used on vertical surfaces as well as horizontal, and rubs with the same material used in hand rubbing.

The machine for rubbing out painted automobile bodies twice as fast as it can be done by hand

Testing Piston Rings

THE insuring of a supply of piston rings of known strength on a more or less standardized basis is not an easy matter with the ordinary commercial equipment and gages found in shops, especially when they have to be turned out at a competitive price. The little gage shown has been introduced by a Swiss firm to overcome this difficulty. Its object is to determine whether the pressure exerted on the walls of the cylinder when the ring is compressed to its working diameter is within allowable limits.

A steel ring is mounted on ball-bearings inside the circular casing and has several radial slots in its upper face, as shown. Pivoted to the casing are a number of bell crank levers. The roller on the outer end of each lever fits into one of the slots in the ring; the roller on the other end of the lever bears on the outer circumference of the ring under test. This is effected by the rotation of the steel ring. This ring carries a projecting finger which engages with a plunger situated in a sliding tube. By pressing the lever which projects from the casing this tube is caused to move toward the gage shown against the pressure of a spiral spring. A spiral spring within the tube presses a plunger up against a shoulder in the same direction, and is therefore carried along with the tube until the resistance to its further motion is sufficient to overcome the compression of the spring acting upon it. This occurs when the finger carried along by the plunger has rotated the steel ring a sufficient distance to cause the rollers to exert pressure on the piston ring. The gage of the instrument has two concentric dials. The reading of one depends on the motion of the tube and that of the other on the motion of the plunger. To set the instrument a steel disk is provided whose diameter is equal to that of the closed diameter

An ingenious device for testing the size of piston rings by measuring their pressure when forced to conform to the cylinder size

of the ring to be tested. It is inserted in the place of the ring and the lever pressed until the rollers touch it. The dial is then rotated until the pointer is at zero. A piston ring of standard strength is then put in in place of the disk and the lever again pressed. When this ring has been closed to the standard diameter, the pointer will, of course, again be at zero, but before this occurs the inner dial will have been actuated by the differential motion of the plunger and will take up a position which depends on the relation between the reaction of the piston ring and the initial compression of the spring which holds the plunger up to its work. Means are provided for adjusting this compression, and when the machine is properly set the effect of closing it on a ring of standard size and strength is to bring the pointer to zero on the scale of sizes, and between two limit marks on the scale of strength.

Automatic Saw Sharpening

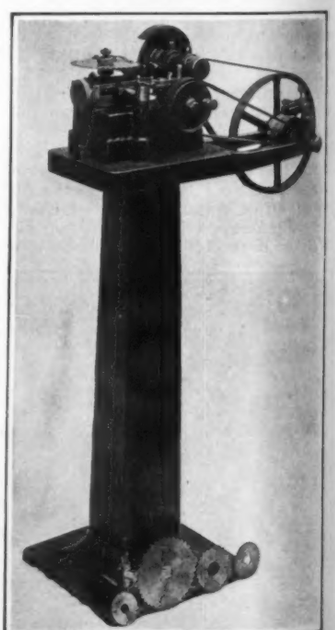
WE illustrate herewith an automatic saw sharpener, designed to sharpen and reclaim slitting saws, slotting cutters, jeweler's saws, etc., from the smallest sizes up to a diameter of eight inches. The wasteful practice is common of discarding small circular and band saws of various types as soon as they are dulled, with the idea that reconditioning cannot be done at a cost making it profitable. On this machine they can, with negligible cost, be resharpened until they are completely worn out. A very interesting feature is that the indexing is done by the saw being sharpened, so that differences in the distances from tooth to tooth present no difficulties. In fact, even when teeth are wholly missing the saw can still be worked over on this machine, without any trouble in the feeding.

A press for the hot adhesion of photographs, engravings, drawings and the like

Hot Press for Photographs

OF a recent Paris design, the new press which is shown in our photograph is a considerable improvement in the way of adhesion of photographs, drawings, or the like, by the use of the hot process. In the first place, since the cost of metal is high, the new press is designed so as to do all the required work by means of a light but very strong device, and it is adapted to mount photographs or like pieces in 8 by 10 inch size with margin. Such pieces are inserted in the press by placing them on the flat-bottom base between the uprights. Electric heating is employed, using a socket plug and flexible cord.

The movable top part is brought down by means of the upper handle upon the photograph and backing—for instance, cardboard, these having been laid upon the solid base. At the front is seen a thermometer for checking the temperature, and at the top is a slide which serves to modify the heat by acting upon the electric resistance used for the heating. Quite a considerable heat can be obtained, up to 212 degrees F. The photograph or other sheet is coated with adhesive preparation and is put upon the backing; the top part is then pressed down by using the lever, and the pressure is applied for about two seconds, resulting in a fine adhesion of the photograph, especially at the edges.



An automatic resharpener for circular and band saws of every description

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Potash from Lava

THE search for potash goes on in all countries. A new method has been developed, which is a commercial success it is claimed, of extracting potash from lava in Italy. The large volcanoes in that country furnish an apparently inexhaustible supply of lava, which contains a considerable percentage of potash, in some cases as much as 20 per cent. The only difficulty has been to extract the potash from the volcanic rock. From the very nature of the process a considerable amount of the reagent is required, and it is essential to the commercial success of the same that this reagent be inexpensive. Such a reagent has been found in hydrochloric acid, which is made synthetically.

In Italy, as in this country, most of the caustic soda used is made by the electrolytic process. Likewise, the market for caustic soda has always been able to absorb all of the production, while in the case of chlorine, which is evolved simultaneously in the electrolytic caustic soda process, the market has almost constantly been too weak to take care of the large production of this material. The result has been that much experimentation has been carried on with a view of locating new uses for chlorine. The potash extraction process by the aid of synthetic hydrochloric acid is a reflection of this activity. The process is being worked commercially and gives a high grade of potash. In addition there is produced very pure alumina, which finds a ready market as well. For further details see *Chimie et Industrie*, 1922, 425.

Light-Resistant Lithopone

LITHOPONE is one of the most popular white pigments known, and it would find even greater application if it were not for one disadvantage that it possesses, namely, that it discolors when exposed to light. A surface painted white with lithopone and exposed to the sunlight will soon darken. Almost as old as the pigment itself are the attempts to counteract this deficiency in some way. A great deal of research has been done on this subject with varying degrees of success. Just exactly what happens is not positively understood, but the conditions governing the darkening of lithopone seem to be fairly well understood. It is known that small traces of certain impurities, particularly of chlorides of iron, cobalt, nicket, etc., accelerate the darkening process very considerably.

In the French journal *La Revue de Chimie Industrielle*, 1922, 109, there is described a very interesting and apparently perfectly effective method of avoiding the darkening of lithopone that does not contain any impurities. It is claimed that the ultra-violet rays in sunlight are responsible for the blackening of surfaces painted with lithopone paint and exposed to the sunlight. Certain materials are not affected by these rays and do not permit them to pass through their substance. Oxide of zinc, alumina, *blanc fixe* are examples of such materials. These are white in color and when added to the lithopone so that each particle of the latter is surrounded with an impenetrable and unaffected coating of alumina or zinc oxide, the resulting pigment is not impaired in any way; its color is just as good and its covering power just as effective, but it will not darken on exposure to light. Practical tests with such a product have proved to be altogether satisfactory.

Casein Primer

A SOLUTION of commercial casein in sal ammoniac is claimed to make a very effective primer for wooden surfaces no matter how porous they might be. The casein solution can be mixed readily with all sorts of pigments and one coat of the composition, painted on the wood, will give a smooth, uniform coat, on which the paint may be applied with good results. Further details regarding the making of this primer are given in *Gewerbefleiss*, 1922, Number 2.

Artificial Petroleum

THE French are still looking for native sources of petroleum. If they cannot find the oil itself in France or the French colonies, they are content to make it from other products of domestic origin. The goal which they are working for is to supply all the needs of the mother country by manufacturing the desired products from raw materials grown in the colonies. So it is not strange to see them experimenting with such a product as colza oil or rapeseed oil. In *Comtes Rendues*, volume 173, page 658, there is given a report of such experiments which, it is claimed, yielded a product bearing a close resemblance to crude oil. The oil is decomposed in the presence of a compound catalyst, made from copper and alumina, at a temperature of 550 to 650 degrees C. The products are then hydrogenated twice, once at 180 degrees C. and again at 350 degrees C. The final result, a greenish liquid, is an artificial petroleum.

Potassium Dichromate

AN excellent article, describing the manufacture of potassium dichromate in detail, is published in *L'Industrie Chimique*, 1922, pages 143 to 147. The conditions under which the various stages in the process are carried are given; temperatures, pressures, concentration of solutions, proportions of reacting ingredients are indicated. The analytical control of the operations is emphasized.

Technical Application of Radio-Active Energy

GERMAN investigators have found that water containing radio-active substances can be disintegrated into its elements, hydrogen and oxygen, much more easily than non-radio-active water. It is accordingly possible to reduce the amount of energy required for the decomposition of water in the production of pure hydrogen for making ammonia, etc. This is of the highest importance technically and represents a possible application of radio-activity which has not been thought of heretofore. (From *Chemiker Zeitung*, 1922, 347.)

Coal Tar in Preserving Timber

TECHNICAL Paper No. 268, Bureau of Mines, contains an interesting and informative account of the use of coal tar in preserving wood. The tar fills the pores of the wood and prevents decay, not only by its antiseptic properties but by its water repellant qualities as well. In preserving fence posts, telephone poles and heavy building timbers it is applied with a brush dipped in hot water-free tar. It is used in much larger quantities in admixture with creosote oil for the treatment of paving blocks, railroad ties, cross arms and telephone poles. Pressure tanks, wherein the preservative mixture is forced into the pores of the wood, are used in this method of treatment. Some of the ingredients in the tar are better preservatives than the tar itself, but the low cost of the tar favors its use in preference thereto.

Distilling Clay

THE Bureau of Mines engineers have devised a method of distilling clay similar to the manner in which coal is distilled. The object of this method is to collect the products of distillation and determine the gases given off.

"Copal Oil"

THIS is a new oil which is distilled from the seeds of a variety of plants that grow in the Belgian Congo. There appears to be quite a variety of these trees, growing in different sections of that country. The oil has a greenish color and scarcely any odor, and a rather agreeable taste. It was first thought that it could be used in the manufacture of paints and varnishes, but a series of drying tests indicated that the time of drying of a film of the oil was too prolonged to warrant such an application. The color of the oil can be removed by clarification processes and the product obtained then may serve as a substitute for high-grade salad oil. For further details, see *Les Matieres Grasses*, 1922, 6094.

Decolorizing Palm Oil

AN investigation has been made to determine if it is possible to remove the color from palm oil and produce a product which could be used satisfactorily in competition with other edible oils as a salad oil. The results of this investigation are given in *The Chemical Age* (London), April 29, 1922. It appears that the most effective method of bleaching is by the aid of nascent hydrogen. Sulfur dioxide was found to be ineffective as a bleaching agent.

Titanium White

A VERY interesting and informative account of the various methods employed in the manufacture of titanium white is given in the French journal, *Chimie et Industrie*, 1922, page 651. The article is written by the well-known French paint technologist, C. Coffignier. The various Norwegian, French and American methods of manufacture are discussed and the properties of each grade of pigment are described. The conclusion is drawn that at the present time the only product that can be used with any degree of success in competition with the older white pigments, white lead, zinc white and lithopone, is the titanium white made in accordance with the Norwegian method of manufacture.

Lubrication with Oil Emulsions

IN the *Zeitschrift Verein Deutscher Ingenieure*, volume 65, number 10, there is given an account of an important series of experiments made to determine the feasibility of using oil emulsions in the lubrication of the cylinders of steam engines. It was found that a considerable saving was effected by the use of an emulsion of mineral oil in lime water. A very careful test was made on the engine to determine the available power transmitted in driving a dynamo when such oil emulsions were employed. The results proved that lubrication with oil emulsions was more efficient than with oil alone.

Hexalin in the Soap Industry

DURING the war the Germans, hard-pressed for solvents, developed a process of hydrogenating naphthalene, ordinary tar camphor. By varying the degree of the hydrogenation—that is, by adding different numbers of hydrogen atoms to the naphthalene molecule—they were able to secure a series of liquids which possessed very interesting and important properties. Since the close of the war numerous uses have been developed for these solvents, some of which have been described on this page of SCIENTIFIC AMERICAN. At the present time all the products can be bought in Germany in commercial quantities.

One of these products, which is known as hexalin, representing the addition of six hydrogens to the molecule of naphthalene, has found important application in the manufacture of soap. It will dissolve readily fats, oils, resins of all sorts. Highly oxidized fats are more soluble in it than in any other solvents. It will give a perfectly clear solution with very strongly diluted aqueous soap solutions. In this way soap solutions can be made which have the properties of turkey red oil soap or castor oil soap. The solvent is also very useful in dissolving out grease stains from fabrics, and hence it is of particular value in the manufacture of textile soaps. For further details, see *Seifensieder Zeitung*, 1922, Nos. 11 and 12.

Copper Salts in Casein Glue

THE Forests Products Laboratory at Madison, Wis., has found that the addition of copper salts to casein glues improves the product considerably. It increases their resistance to moisture and also makes them most durable when exposed to the action of fungi and molds. About 2 to 3 parts of the sulfate are dissolved in 300 parts of water and then added to 500 parts of the ordinary casein, lime and water glass glue.

Spongy Rubber

IN making spongy rubber it is usual to incorporate with the rubber mass some material, usually an ammonium salt, such as ammonium carbonate, which will be converted into a gas at the temperature of vulcanization and cause the rubbery mass to fill out with air pockets. Another method of accomplishing this effect is described in British Patent No. 172,398. The rubber mixture is made from Para and reclaimed rubber, sulfur, zinc white and magnesium carbonate, and to this there is added 10 pounds of a volatile mineral oil, such as petroleum ether, for every 45 pounds of the rubber composition. Vulcanization takes place in a steam-heated cylinder at a pressure of 40 pounds per square inch for a period of one hour. This oil is vaporized with the production of spongy rubber.

The Heavens in September, 1922

What the Astronomers Will Do in Pursuit of Einstein's 1¾ Seconds of Arc

By Professor Henry Norris Russell, Ph.D.

THE principal astronomical interest of the present month undoubtedly attaches to the total eclipse of the sun upon the 20th. This is a notable one, for the moon is actually at perigee during the eclipse, so that the point of the shadow reaches unusually far beyond the earth, and the dark spot which it produces upon the earth's surface is exceptionally large, reaching a diameter of 140 miles. Moreover, it falls in the equatorial regions, so that the earth's rotation carries the observer rapidly in the direction in which the shadow is moving, and hence prolongs the time of its passage. The combined influence raises the duration of totality to the unusual maximum of six minutes—less a couple of seconds. The opportunities for observations of all kinds are therefore unusually favorable—except for one circumstance, which remains to be mentioned; by far the greatest part of the eclipse track lies in the open ocean.

At its very beginning it passes for a few hundred miles over Africa, south of Somaliland; but the sun will be so low for observers here that it would be useless to attempt scientific observations. Then begins a vast sweep of the Indian Ocean, interrupted along the eclipse track only by some coral islands of the Maldive group, southwest of India, and the isolated Christmas Island, south of Java. Land comes at last, with the Australian coast; but on the shore, and for a thousand miles or more inland, it is a most forbidding desert. In the eastern part of Australia, near the borders of Queensland and New South Wales, a more practicable country is reached, with railroads and towns; but here again the sun is low, for the end of the track (out in the Pacific) is not far off.

The practicable eclipse stations, where the sun will be high and the weather promising, appear to be confined to the islands in the Indian Ocean and the desert stations in Australia.

It is doubtful whether much effort would be made to occupy such inconvenient places, if it were not that this will be the last chance for a number of years to settle the question of the bending of light rays by the sun's gravitation, as predicted by Einstein. The observations of 1919, though fully enough to satisfy those who are familiar with all the intricacies of photographic measurement, showed certain small discrepancies, probably arising from defects in the apparatus. The earlier results worked up at the Lick Observatory, though also favorable to the relativity effect, were not quite decisive. One new set of observations, secured with instruments specially designed for the problem, and under good conditions, should settle the question beyond cavil. At the present eclipse the sun is in a region rather poor in stars; but the long duration of totality compensates for this, and will make it possible to secure satisfactory photographs—if only the weather permits.

Where the Eclipse Will be Photographed

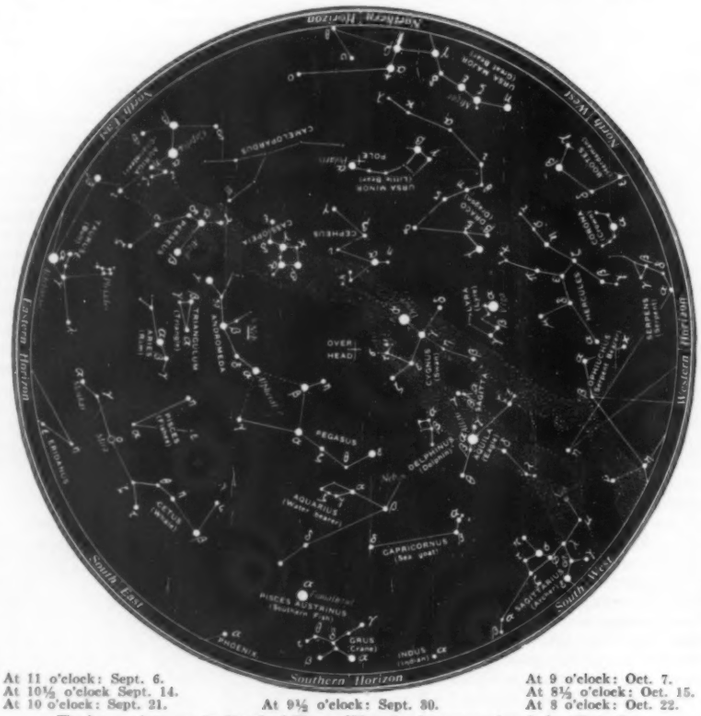
Several expeditions, therefore, are under way. A German party, including Professor Einstein himself, will be in the Maldives; an English party at Christmas Island; and our most experienced American observer of eclipses, Professor Campbell, on the northwest coast of Australia; while Australian astronomers plan to work in the interior of that continent, and some smaller parties will be at the stations already named. The problem of transportation, for some of the adventurers, will be no simple one. The Greenwich observers (who are already on Christmas Island, and plan to do an important piece of photometric work while awaiting the eclipse) had to remain in the offing, tossed about in a very small steamer, for more than a week before the sea was smooth enough to permit a landing. And the voyagers to Australia are likely to have more remarkable tales to tell.

The Lick Observatory party, after crossing the Pacific by steamer and the Australian continent by rail, will travel more than a thousand miles on a gunboat—generously detailed for that purpose by the Australian Government—and land on Ninety-Mile Beach, where the only way of getting ashore is in surf-boats, and the tide has a range of 20 feet. Water, and possibly a few sheep for food, are procurable at a ranch near the shore. Everything else will have to come thousands of miles.

It may be permissible to mention one detail, which Dr. Campbell told the writer and which illustrates the thoroughness of his preparations. The upsetting of a single boat in the surf might lead to the loss of essential parts of the instruments. Hence, among the equipment ordered in Australia will be a suitable number of stout, water-tight barrels, which will be firmly lashed to each heavy package. Should the boat capsize the barrels will serve to float the cargo ashore, case by case, and it can be recovered when the ebb-tide leaves it stranded.

Needless to say, the precautions taken on the technical side will be fully as complete. The description of these will come when Professor Campbell makes his report; but it may be mentioned that the comparison plates of the same stars when the sun is in another part of the sky will be taken in the Island of Tahiti, since it would be impossible to wait for months in the desert to take them there. Very complete checks and controls upon the permanence of the instrumental adjustments will also be made. The scale of the whole expedition is very well illustrated by the fact that some of its members will return across the Pacific and others via Europe—since to go around the world is almost the shortest way home!

One of the Australian parties plans a still bolder trip, to an almost unknown desert region, which can be reached only by a journey of some weeks with a camel train. The chances that good weather will bless these desert parties are very favorable; and we may hope that, when the photographs have been measured and the results worked out, the great observational test of the Theory of Relativity will have been completed, once for all.



At 11 o'clock: Sept. 6.
At 10½ o'clock Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

In picking out the constellations, we may begin with the great square of Pegasus, which is conspicuous high in the southeast. Its western edge points northward, past Cassiopeia and Cepheus, to the Pole-star, and to the Great Bear below it. Carried southward, and trending a little to the west, it reaches Fomalhaut, and the southern constellation of the Crane. The eastern side of the square points southward to the brightest star in Cetus. The rest of this large constellation lies to the left, and can be picked out with the aid of the map. From the northeastern corner of the great square a line of conspicuous stars runs through Andromeda and Perseus, whose brightest star, Capella, is low in the northeast. Aries is well up in the east, and Taurus rising. In the opposite quarter we find Cygnus and Lyra, very high, and Hercules and Corona below. Farther to the left is Aquila, above the setting Sagittarius. Aquarius and Capricornus occupy a dull region in the south.

The Planets

Mercury is an evening star all through September, and is farthest away from the sun in the sky on the 20th. His elongation is then unusually great—26½ degrees—but he is more than 10 degrees south of the sun and is therefore not very conspicuous, setting at 6:45 P. M. (standard time, as always).

Venus, too, is an evening star, and reaches her greatest elongation on the 15th—46 degrees 24 minutes from the sun. She is still farther south, and sets at 7:45 P. M., so that she is less conspicuous than she was earlier in the year.

Mars is in Sagittarius, receding from the earth and growing fainter. He crosses the meridian shortly after sunset, and remains in sight until 11 o'clock.

Jupiter and Saturn are evening stars, setting at 8:10 P. M. and 7 P. M., respectively, at the beginning of the month. Not long afterward they are lost in the twilight. Mercury is in conjunction with Saturn on the 8th, and with Jupiter on the 21st; but in both cases the planets will be very low in the west.

Uranus comes to opposition on the 4th, and is just visible to the naked eye. At that time he is in 22h 33m 20s R. A. and 7 degrees 58 seconds south declination, and is moving a little less than 9 seconds westward and 1 minute southward per day. This places him 1¼ degrees due east of the fourth magnitude star Lambda Aquarii, which may itself be found about 3 degrees east of the line joining Zeta and Delta Aquarii (shown on the map), and a little nearer the latter. The planet is barely visible to the naked eye, but is conspicuous in a field glass. By making a sketch map and watching for his motion, he may be certainly identified.

Neptune is a morning star, rising about 4:30 A. M. in the middle of the month.

The moon is full at 3 A. M. on the 6th, in her last quarter at 5 A. M. on the 14th, new at 11 P. M. on the 20th, and in her first quarter at 6 P. M. on the 27th. She is nearest the earth on the 20th, and furthest away on the 7th. During the month she passes by Uranus on the 6th, Neptune on the 18th, Saturn on the 21st, Jupiter and Mercury on the 22nd, Venus on the 24th, and Mars on the 28th.

It may be added that at 3:10 P. M. on the 23rd the sun crosses the celestial equator, southward bound, and "autumn commences."

The Radium Star Map

USERS of star maps find more or less difficulty in the fact that one must look at the stars in the dark, and that in the dark one cannot see a map. It is by no means convenient to pass back and forth between light and darkness, and the use of a flashlight is not much better. A Chicago inventor is putting on the market a radium map, in which the stars of the first four magnitudes, together with the lines showing the constellation groupings, are marked with radium so as to shine in the dark. This map is four feet long and one foot wide, mounted on cardboard for folding; it carries the circumpolar stars on one section, and those that appear to rise and set on another. Dates are given when certain regions of the sky are due north at 9 P. M.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

VARIABLE PITCH PROPELLER.—D. F. ZOOK, 965 N. Holliston Ave., Pasadena, Calif. This invention relates to airplanes; an object is to provide a propeller which has blades so arranged that they may be turned to vary the pitch while the plane is in flight, and arranged so that one pitch may be used, for instance, when "taking off and climbing," and another for high speed and altitude work. A further object is to provide a pitch propeller with which a slower speed motor may be used, thus adding much to the life of the engine.

Pertaining to Apparel

UNDERGARMENT.—N. LIPPMAN, 1262 51st St., Brooklyn, N. Y. One of the principal objects is to combine with an envelope chemise a pair of bloomers. A further object is to provide a combination garment which provides an upper body covering and a lower leg covering portions, said upper garment having depending closure flaps adapted for detachable association with each other, and with the leg covering portions.

COLLAR SUPPORT.—D. FEIGENBAUM, c/o Aero Collar Co., 141 Roebling St., Brooklyn, N. Y. The object of the invention is to provide a construction wherein a soft collar is properly supported without disturbing the usual appearance of the collar. Another object is to provide a support for a soft collar wherein a removable stiffening device is provided adjacent the front of the collar for preventing crumpling of the collar.

BRASSIERE.—A. ZWIEBELSON, c/o Mollie Mayers, 717 5th Ave., New York, N. Y. Among the objects of the invention is to provide a brassiere arranged to insure accurate fitting and to hold it against upward creeping and wrinkling, particularly at the back, to provide a smooth foundation for the back of the outer garment, and to allow a proper fit of such garment mainly at the waistline, and thus provide a proper hang of the garment.

CORSET.—A. ZWIEBELSON, c/o Mollie Mayers, 717 5th Ave., New York, N. Y. The invention has for its object to provide a corset arranged to fit snugly around the wearer's body, particularly at the diaphragm and under the bust, to hold the flesh and ligaments in position without forcing the same out of place to the discomfort of the wearer, and to allow desired freedom without unduly straining the same.

CORSET.—A. ZWIEBELSON, c/o Mollie Mayers, 717 5th Ave., New York, N. Y. The object of this invention is to provide a corset more especially designed for wear by stout women, and arranged to prevent pressure against the front median portion of the wearer's body and to exert uniform pressure on the wearer's body directly under the bust without unduly displacing the flesh. A further object is to give a circular shape to the wearer at the waist and upper portions.

GARMENT SUPPORTER.—H. V. CLAUSEN, Room 530, 15 Park Row, New York, N. Y. The invention is more particularly intended for embodiment in a garter or hose supporter. The general object is to provide a spring connection reflecting important consideration with respect to efficiency and facility with which the band of elastic webbing may be connected or disconnected from the spring, as well as to prevent the spring from resulting in discomfort to the wearer.

GLOVE ATTACHMENT.—A. LENNEBERG, 99 Wicks Ave., Yonkers, N. Y. The invention relates to means for producing a frame or reinforced opening in a glove which may constitute a window through which a wrist watch may be viewed and adapted to accommodate itself to the watch in a manner to prevent discomfort to the wearer of the glove. The frame opening is provided with a cover.

Chemical Processes

METHOD OF PRODUCING CHEMICAL COMPOUNDS FROM ACETYLENE AND HYDROHALOGENIC ACIDS.—W. BAUER, Darmstadt, Germany. The invention relates to a method for the practical utilization of acetylene. By mixing about equal parts of volume of acetylene and an hydrohalogenic acid vinylhalides can be produced. In using acetylene and about double quantity of the acid symmetrical addition products can be obtained. The method consists in exposing the mixture to the action of light.

METHOD OF PREPARING MEAT EXTRACT IN A DRY STATE.—A. CHALOS, 46 Rue Emile Menier, Paris, France. The method consists of extracting the juice or liquid plasma from the muscular fiberin by pressing the same, and submitting the plasma to a rapid evaporation in a high vacuum and at a low temperature, the plasma being admitted into the evaporating device after cooling to a temperature slightly above the freezing point, it being maintained at this temperature by a suitable heating as the evaporation takes place. The extract in a dry state is soluble in water.

METHOD FOR THE PRODUCTION OF COMPOUNDS CONTAINING SILICON AND NITROGEN.—F. VON BICHOWSKY, 1412 San Fernando Bldg., Glendale, Calif. The invention relates to the production of compounds containing principally silicon and nitrogen from crude materials, mainly composed of the oxygen containing compounds of silicon and free from carbon as such, through the agency of catalytic substances so that temperatures lower than previously deemed practical may be employed, thereby avoiding the loss of any appreciable quantity of nitrogen containing material through volatilization.

INSECTICIDE.—M. L. TOWER, c/o Magara Sprayer Co., Middleport, N. Y. The object of the invention is to provide an insecticide compound for the destruction of sucking insects, as, for instance, aphis, pear psylla and red bug, or as a poison for chewing insects. The insecticide comprises 40 per cent nicotine sulfate solution, 2½ parts; plaster of Paris, 5 parts; lead arsenate, 10 parts; tobacco dust, 15 parts, and finely-divided sulfur, 67½ parts.

PROCESS FOR TREATING NUT KERNELS TO PRODUCE FOOD INGREDIENTS.—H. R. and L. E. SCOTT, Don Felipe Apartments, San Jose, Calif. The invention has reference to the treatment of prune, peach, and apricot kernels and deriving therefrom an ingredient of foods in mealy substance that is suited for use in confectionery foods, especially in making a so-called macaroon confection. The process practically results in separating the skins from the kernels, which are then dried and cut or ground and mixed with water, oil and sugar to form a paste.

Electrical Devices

PENDULUM HIGH-VOLTAGE AIR-BREAK SWITCH.—J. K. OSTRANDER, c/o Dwight P. Robinson & Co., 61 Broadway, New York, N. Y. One of the objects of the invention is to provide a high voltage air-brake switch having its parts constructed and arranged to permit a high voltage circuit carrying a large amount of power to be interrupted in air quickly and safely by gravity action through a pendulum construction, with a manually operable or an automatic tripping mechanism.

ELECTRIC CONTACT.—J. B. CHEMIDLIN, 132 Netherwood Ave., Plainfield, N. J. The invention has for an object to provide a construction wherein parts are provided which may be connected to different articles so that when the articles are brought into certain relation to each other the contacts will engage and provide a proper circuit for an electric sign, and when the sign is removed the circuit is opened.

MECHANICAL CONSTRUCTION OF ELECTRICAL MOTORS.—J. J. HOLAHAN, 1707 W. 47th St., Norfolk, Va. The invention relates generally to electrical motors, and more particularly to the mechanical construction in induction motors, the object being the provision of an arrangement wherein the stator may be removed without dismantling the motor in order to replace burned-out coils or core, and whereby the stator may be seated and unseated without the use of special tools.

STORAGE BATTERY CELL.—R. D. MOWRY, c/o Universal Battery Co., 3410 S. La Salle St., Chicago, Ill. An object of the invention is to provide a transparent battery cell having a cover portion which may be sealed while the cell is in its upright position and which may be readily removed without danger of breaking the top, nor of any necessity of tilting the cell from its upright position.

CLOCK CIRCUIT CONTROL DEVICE.—G. A. ALBRIGHT, 21 Latham St., Atlanta, Ga. This invention relates to a circuit control means for electric devices having circuit closers. More particularly to circuit closing means for electric clocks and means for enabling a circuit periodically to be completed, and to vary the period, and to provide a closing means intermittently actuated through a pendulum and escapement mechanism.

Of Interest to Farmers

MECHANICAL COW MILKER.—A. A. ROSENFIELD, 7520 5th Ave., Brooklyn, N. Y. The invention particularly relates to a manually operated device, the object being the provision of a simple, readily adjustable and conveniently attachable and detachable device which is entirely mechanical and will avoid the time and labor of hand milking, as well as the expense of vacuum or other complicated installations.

REENFORCEMENT FOR BEE COMBS.—H. C. DADANT, Hamilton, Ill. The object of the invention is to provide a reenforcement to prevent sagging, distortion and breaking down of the comb foundation on account of atmospheric changes, weight and the heat of the working bees, weight of honey, pollen brood and young unhatched bees, and on account of the stress and strain on the foundation and comb during transportation and handling.

ANIMAL TRAP.—C. H. JOHNSON, Fort Sill Military School, Fort Sill, Okla. The invention relates to a trap which cattle may enter and pass through and in so doing rid themselves of flies and insects adhering to their sides, back, head, neck, legs, underbody and flanks. The device is so constructed that brushes and draped cloth automatically move with the passing of the animal to effect the result, the insects being entrapped and subsequently killed.

GRAIN BIN.—F. R. EDWARDS, Mayguez, Porto Rico, West Indies. The invention has particular reference to a bin in which the grain can be stored and preserved. An object is to provide a bin which is efficiently ventilated, into which insects cannot enter, and which can readily be closed off for the purpose of fumigation. The bin can be shipped in a "knocked-down" condition, and may be readily set up.

FRUIT CATCHER.—G. BOELMAN, Box 60, R. F. D. No. 1, Gridley, Calif. The object of the invention is to provide a convenient device by which fruit falling from a tree may be received, conveyed to one or more outlets and delivered into fruit boxes. A further object is to provide a device that is collapsible, easy to set up, stands firmly around the tree when in use and is easy to take apart for transportation.

Of General Interest

SHUTTER LOCK FOR ROLL FILM CAMERAS.—P. F. BEAULIEU, address R. S. Hamilton, First National Bank Bldg., Bend, Oregon. An object of the invention is to provide a lock for the shutter operating means and a latch acting to prevent the release of the lock, and itself subject to the turning of the film roll for the release of the lock, the latch being adapted to assume its latched position without being dependent on a predetermined point of stoppage, and the operation of the shutter being subject to release by the deliberate turning of the roll film.

EYEGLASSES.—C. D. HILLABOLD, 308 N. Main St., Pueblo, Colo. The purpose of the invention is the provision of a pair of glasses particularly designed for near vision and having lenses of such size and shape that they completely intercept one's vision only when reading so that they cannot be accidentally used for distant vision. The glasses are of a very small size and when worn are practically invisible at a short distance.

RETAINING DEVICE FOR WINDOW PANES.—F. SIMA, 11 E. 9th St., Whitestone, N. Y. One of the principal objects is to provide a simple, inexpensive and effective means for positively retaining a glass in the frame against displacement in cooperation with a small quantity of putty for sealing the puncture of the edges of the pane with the window frame, said means operating to completely cover and house the putty to protect the same against the elements.

PAPER WEIGHT.—H. FROMKESS, 560 E. 158th St., New York, N. Y. Among the objects of the invention is to provide a paper weight in which it is not necessary to lift the weight to place papers thereunder, and to so construct the weight that a maximum holding property is maintained with the minimum amount of weight employed.

PACKAGE.—G. J. LOVELL, Box 54, Springfield, Ill. The invention more particularly relates to a type of package primarily designed with a view of permitting the safe transportation of phonograph records and similarly perforated discs, and by means of which the records may be quickly packed and the danger of breakage or loss during shipment reduced to a minimum.

PIN.—H. M. THOMAS, 255 W. 84th St., New York, N. Y. The invention aims to provide a device which is adapted for use in connection with rolls of any material, but more particularly linoleum and oil cloth. This material usually comes in six-foot widths and considerable space is required for permitting a severance of a desired length. The pin is adapted to receive and extend over the entire width of a strip of material so that it may be marked and severed while in an upright position.

SUPPORTING PIN AND CUTTER.—H. M. THOMAS, 255 W. 84th St., New York, N. Y. The invention relates to the device described above, permitting a roll of material to be manipulated while retained in a vertical position. An object is to provide a cutting mechanism, associated with the pin, so that this part of the operation may be more readily accomplished. The device may be readily associated with and detached from the roll.

ROOFING TILE.—A. DE JULIAN, West Palm Beach, Fla. The object of the invention is to provide a tile of the character specified, formed from plastic material as for instance, cement, concrete or the like, wherein the tile is of such construction that it can be made in a variety of lengths and require no special skill in laying.

MATTRESS BORDER.—J. M. ELDREDGE, 3344 College Ave., Indianapolis, Ind. The invention relates more particularly to a border adapted to be made independently of the mattress and constructed to prevent longitudinal or transverse stretching, so that when applied to the mattress it functions to prevent stretching of the mattress in any direction and maintains the original dimensions. The device when applied provides the roll edge and improves the appearance of the mattress.

MAIL OR THE LIKE BOX.—C. E. ARNOLD, 724 E. St., San Diego, Calif. The invention has for its object to provide a metal receptacle for holding mail before its collection by either the mail man, or the addressee. The primary object is to make a slight departure from the conventional type of mail box, by cutting a relatively deep and wide opening at the upper back portion for accommodating envelopes too large to be received in the box itself.

WALL CONSTRUCTION.—J. H. LEWIS, 2733 So. 60th St., Cicero, Ill. An object is to provide a wall construction made up of suitable supporting frame and slabs of a hardened plastic material provided with means for securing the slabs in determined

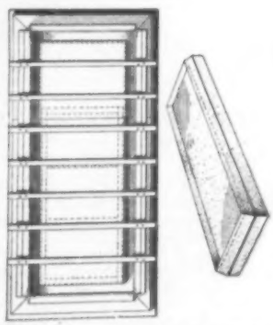


Fig. 1: Cast or moulded burial vault devised by C. B. Franklin

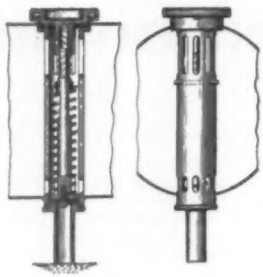


Fig. 2: Double-acting valve for tanks and reservoirs, invented by W. F. James

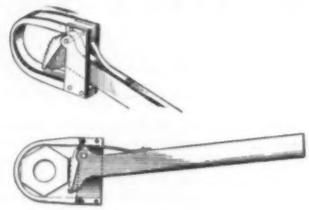


Fig. 3: Adjustable wrench of new design, patented by E. C. Soleman

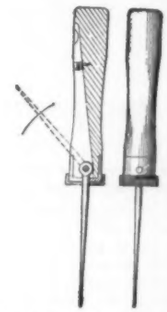


Fig. 4: J. A. McWilliams' ice pick, with blade which may be sheathed in the handle

positions. A further object is to provide a wall construction having a combined reenforcing and securing member partly embedded therein.

HIGHWAY TRACK.—C. T. ELDRIDGE, 3750 24th St., San Francisco, Calif. The invention has for its object to provide metal tracks for macadamized or concrete road-beds by means of strong, cheap and light rails inserted in the road-bed. The rails are supported on T bars and are reinforced by a plurality of cross bars, binding the rail and roadbed into a solid structure.

COIN HOLDER.—R. WALLENSTEIN, North Attleboro, Mass. The object of the invention is to provide a coin holder more especially designed for the use of shoppers and other persons arranged to enable the user to readily manipulate the delivery of coins of various denominations in a very simple manner and without the user handling the coin.

PACKING CASE.—H. H. READ, 84 Cranley Gardens, Muswell Hill, London, England. According to the invention the contiguous portions of adjacent sides of a packing case are secured together by means of strips of hoop iron passing through slots in the marginal portion and around the edge of the sides, the overlapping portions of the strips being nailed to the sides and secured together by means of solder or the like which covers the heads of the nails.

COPY HOLDING DEVICE.—A. N. WOODRUFF, Box 1907, Washington, D. C. One of the objects of the invention is to provide a device which will support a manuscript to be copied, in a convenient position for the operator. A further object is to provide a line-spacing mechanism, and to provide a device which may be folded when not in use to occupy but little space.

INFANT'S BATH CHAIR.—F. J. REILLY, 505 W. 183rd St., New York, N. Y. The invention relates to a folding chair particularly adapted for infants and has for an object to provide a construction which may be readily set into a tub for supporting a child a short distance above the bottom thereof and at the same time allowing a comfortable posture to be assumed by the child during the bathing operation.

HAND BAG.—J. O. DOERSCHING, 519 Union St., West Hoboken, N. J. Among the objects of the invention is to provide a frame for hand bags in which the covering associated with the frame may be supplanted with any different covering, which will permit of the changing of its appearance, and making it possible to match the bag to different gowns of the wearer.

PACKAGE TIE.—W. H. DUVARNEY, 48 Franklin Ave., Derry, N. H. An object of this invention is to provide a fastening device which will operate to conveniently and securely couple the ends of a cord, after the latter has been placed around the package so that the tie can be used over and over again without knotting the cord. The device is constructed of wire which is so formed as to exert a continuous spring action, maintaining the cord in secured position.

CONTAINER.—H. L. CARPENTER, 459 Washington Ave., Brooklyn, N. Y. This invention relates to a simple, strong, and compact container which can be very easily assembled and disassembled, and which when assembled is proof against leakage from the container, and also proof against leakage of moisture into the container. When disassembled the container may be collapsed into a small form for shipment or storage.

FOLDING BED.—L. ROTHFELD, 177 E. 93rd St., New York, N. Y. This invention aims to provide a convertible article in the nature of a bed or a davenport in which the operating parts will be simple, extremely neat in appearance, and will also provide ample space for the storage of a mattress as well as other necessary articles of bedding. The device is simple in arrangement and relatively inexpensive to manufacture.

COLLAPSIBLE RECEPTACLE.—H. H. BAIN, Texas Ave. and Reynolds St., Shreveport, La. The primary object of the invention is to provide a sheet-metal container or tank which is formed in a number of sections which may be collapsed or nested one within the other so as to economize space in transportation, but which may be readily erected to form a full-sized tank, to be used for the storage of liquid, grain, cotton or cotton seed, etc.

TUNNEL AND SHAFT LINING.—B. H. M. HEWETT and S. JOHANNESSON, address S. Johannesson, 168 Alexander Ave., Upper Montclair, N. J. Among the objects of the invention is to provide a tunnel or shaft lining which is capable of use in connection with tunnels of various cross-sectional shapes and dimensions, in which the joints or seams are rendered water-tight without the caulking usually employed, in which a minimum weight is used for any given set of conditions, and which is so constructed that a large portion of the erection work may be carried out exteriorly of the tunnel.

GOLF HEAD.—D. S. GRIFFIN, Hudson Falls, N. Y. The invention relates to a perforated metal head for golf clubs, which will be light in weight, and which will be less resistant to the air than metal heads now in general use. A metal insert or plug of copper, brass or similar bright metal, is located at the central portion of the head, which marks the point at which the head should properly come in contact with the ball for the most efficient drive.

DESK FILE.—J. C. HISLOP, 197 Market St., Newark, N. J. An object is to provide a construction which will readily adapt itself to a desk or a file cabinet. Another object is to provide a file in which a foundation plate is used associated with a plurality of easily adjusted division plates capable of movement to any desired place whereby the space may be divided as required, and in which the device may be readily set up and taken down and will occupy a minimum of space in either operative or collapsed position.

DIVER'S SUIT.—V. CAMPOS, Plaza de Garibaldi, N. 14 Mexico D. F., Mexico. The object of the invention is to provide a diver's suit arranged to relieve pressure and to allow the diver to descend to a considerable depth. Another object is to prevent leakage at the joints even when descending to a considerable depth, and to enable the diver to readily move the arms and legs and to do submarine work at practically any depth.

CLOTHESLINE SUPPORT.—O. L. SCHASTEY, 1062 Putnam Ave., Brooklyn, N. Y. The invention has for its object to provide means for supporting an endless clothesline in such a manner that clothes may be hung upon the line within a room and the line then operated to move the clothes through a window out into the open. An object is to provide a support which will entirely obviate the danger of accidents and falls from the window.

TRAFFIC GUIDE OR SIGNAL.—W. L. BROWN, 58 W. 8th Ave., Gloversville, N. Y. The general object of the invention is to provide a guide or signal for directing traffic in streets and highways. The device is of simple construction adapted to display at its four sides a desirable legend, such as "Keep to the right," and having means to illuminate the interior, and means for suspending the device on the cable of an electric-lighting system, and affording ready access to the light.

MEANS FOR CLOSING GLASS BOTTLES FOR CHLORIDE OF ETHYL AND OTHER VOLATILE PRODUCTS.—J. BENGUE, 47 Rue Blanche, Paris, France. This invention relates to a closure for the purpose above described, the closure comprising a cap, a rubber disk in the cap, and a thin, pliable tin disk approximately of the same size as the rubber disk on the inner face of the same.

BURIAL VAULT.—C. B. FRANKLIN, Pineville, La. The object of the invention is to provide forms by which a ready-to-use waterproof vault for burial caskets may be molded or cast. A further object is to so construct the forms that they may be adjusted to mold vaults of different lengths. A V-shaped groove is provided at the sides and a V-shaped projection at the cover, which may be hermetically sealed by pouring in grout and then placing on the lid. (See Fig. 1.)

OIL TANK VALVE.—W. F. JAMES, c/o Public Health Service, Honolulu, Hawaii. An object of the invention is to provide a construction of double acting valve for use in tanks or reservoirs from which the fluid is required to be fed intermittently into a chamber below in which the level is maintained constantly by liquid seal action. A further object is to so construct the parts as to prevent the simultaneous removal of the cap and the valve, but permit the independent opening of either. The device is so constructed that it is adapted for use in connection with water coolers, or other analogous purposes. (Sss Fig. 2.)

PICTURE CONSTRUCTION.—P. A. RONTEY and R. TAYLOR, c/o Pierre A. Rontey, M. D., Post Road and Meach Ave., Cos Cob, Conn. This invention relates more particularly to a device comprising a plurality of elements which are independently movable and which cooperate to form different pictures, an object being to provide a device which is capable of a wide latitude in operation to form various pictures. The device is both amusing and educational, and may be manufactured to sell at a reasonable price.

COLLAPSIBLE TENT.—R. T. REED, 316 Wheeler-Kelley-Hagney Bldg., Wichita, Kans. The object of the invention is to provide a device capable of use in any connection, but especially adapted for children's play tents, wherein a folding frame is provided having a flexible cover and so arranged that the supporting elements of the frame may be folded down flat upon each other, with the cover, for purposes of transportation or storage.

STEPLADDER.—F. J. CARONA, 401 Winthrop Ave., Long Island City, N. Y. The invention relates to stepladders having extra supports in the form of side props. The object is to provide an arrangement to insure a firm hold on the floor without danger of toppling over sidewise, to permit of readily setting up the ladder on an ordinary floor or on uneven ground or other support.

SHAFT ATTACHMENT.—G. G. PURCELL, 1243 E. 10th St., Brooklyn, N. Y. The object of the invention is to provide, in combination with a shaft, sills within the shaft and partitions hingedly secured to the sills, adapted to cooperate with the same to provide substantially a fireproof closure. It is also an object to provide means for quickly moving the partitions into closed position, so as to confine any fire to a limited area.

GARMENT HANGER.—P. D. WEEKS, c/o Florence B. Rusbacher, c/o All Styles Hanger Co., 303 5th Ave., New York, N. Y. The invention aims to provide a garment hanger which is extremely simple, and may be manufactured at a nominal figure. An object is to provide a device consisting of a pair of bars pivotally secured together and adapted to be collapsed, and a third bar forming a triangle, the lower member permitting of a lady's skirt being supported, the upper portion being free to receive other garments.

Hardware and Tools

BALE HOOK.—H. C. LEADLEY, 23 Wilmont Ave., Port Richmond, S. I., N. Y. The primary object of this invention is to provide a single hook with a plurality of detachable bale engaging devices which may be readily attached to the free extremity of the hook to adapt it to many usages, one of the attachments being a plurality of small points to prevent unlimited penetration into bags and the like.

SOCKET WRENCH.—O. J. WILLIAMS, Orchard Park, N. Y. Among the objects of the invention is to provide a wrench in which the jaws are firmly compressed against torsional strain, and to provide an actuating means for the jaws, to produce a tool which will be simple, strong, efficient in use, and practical in construction.

SINGLE BLADE PLANE.—H. ANDERSON, 2850 School St., Oakland, Calif. The particular object is to provide a plane that is capable of very fine adjustment, comparatively simple in construction and that holds the blade in such an adjusted manner that it can be used as a block plane as well as a smoothing plane.

VALVE.—P. J. HUSSEY, 2731 Cleinview Ave., Cincinnati, Ohio. The invention relates to such valves as utilize a ball body. The object is to construct a valve of this nature in which any objection incident to chatter will be avoided and by means of which the jet fluid discharge will be solid, the size of the jet will be only limited by the cross sectional area of the valve.

TOOL.—D. ROBERTS, Wilkinsburg, Pa. The object of this invention is to provide a tool for use in tool making, or wherever holes are to be bored and accuracy is essential for measuring accurately from the true axis of the spindle of a boring or drilling machine tool, when the holes are to be placed in work at accurate positions and dimensions and to do this with the greatest saving in time.

WRENCH.—E. C. SOLEMAN, R. No. 2, Box 28, Hammond, La. The purpose of this invention is the provision of a wrench including a stationary jaw and a pivoted jaw, the former being constructed to accommodate nuts of various sizes and shapes with the latter adjustable to cooperate with the stationary jaw in effectively gripping a nut so that when the wrench is actuated a turning of the nut is effected. (See Fig. 3.)

ICE PICK.—J. A. MCWILLIAMS, c/o W. J. Shedd Co., 117th St., Prairie and Calumet Ave., Chicago, Ill. An object of the invention is to provide a simple ice pick in which the blade is so arranged that it may be fully extended and rigidly held in operative position, or may be sheathed in the handle when not required for use, the device is provided with means for releasably holding the blade against movement from its sheathed position. (See Fig. 4.)

SCREW DRIVER.—W. L. McLEAN, 539 Octavia St., San Francisco, Calif. Among the objects of this invention is to provide a simple and substantial screw driver of the manually-operated mechanical-shaft type, in which the rotary movement is transmitted to the bit or chuck by means of a spiral-shaped shaft and a nut cooperating therewith. Another object is to provide a handle and casing for the support of the spiral shaft.

FASTENER FOR DOORS AND THE LIKE.—L. H. GOROWITZ, 227 E. 119th St., New York, N. Y. The invention relates to locks for doors, dormer windows, and other hinged closures. An object is to provide a strong fastening to take the place of the ordinary door chain, which secures the door in closed position or in partially open position, and which effectually prevents entrance when the fastener is in either of said positions. This fastener can be readily positioned on any door or hinged closure.

GRINDING TOOL.—P. U. LOVELACE, Clinton, Okla. More particularly the invention relates to tools for grinding or truing the surfaces of crank-shafts or other cylindrical bodies, an object being to provide a tool comprising a pair of curved grinding stones, and an arrangement of clamping bars and bolts for securely holding and backing the stones during the grinding operation.

LUMBER-JACK SAW.—H. A. KNOWLES, Stockport, Iowa. An object of the invention is to provide an automatic saw that has means for holding the cutting member in constant operative engagement with the work. A further object is to provide means for removably securing the device in position to engage with either horizontally, vertically, or obliquely disposed work. A still further object is to provide a device which is readily portable.

FLEXIBLE CHAIN WRENCH.—W. L. BESSOLO, Clearwater, Calif. The primary object of the invention is the provision of a chain wrench which may be utilized for various purposes, including its application to pipes and rods, and which may be quickly adjusted under ordinary circumstances. A further object is the provision of a wrench by means of which maximum leverage may be applied both against the work and to lighten the gripping chain.

ATTACHMENT FOR PIPE CUTTERS.—H. W. LOOSE, 293 17th St., Brooklyn, N. Y. The primary object of the invention is to provide an attachment which may be quickly and rigidly attached to a cutter, which may be used in connection with a pipe cutter to permit of the cutting of various sized pipes with the same cutter, and which will be simple, practical and durable in use.

ADJUSTABLE WRENCH.—M. A. CAPOBIANCO, Box 481, Sea Cliff, N. Y. An object of the invention is to provide a simple, strong and economically manufactured wrench especially adapted for use on automobiles. A further object is to provide a wrench which can be stored away in a very small compass and at the same time is capable of being adjusted for use in connection with a wide variety of sizes of nuts.

FASTENING DEVICE.—C. B. PETERSON, 2106 N. 15th St., Philadelphia, Pa. The invention relates to a driven fastening device, such as nails, spikes and the like. Its object is to provide a device of this character which is of simple construction, and when in use is interlocked with the material with which it is associated, whereby it is positively prevented from accidental displacement and firmly maintained and positioned to exert its fastening action.

CUTLERY.—E. J. ZINN, 954 Wyoming Ave., Kingston, Pa. An object is to provide a knife blade having a central cutting portion relatively thin, and at the sides of which softer metals are fixed, so that the cutting portion of the blade can be easily sharpened by rubbing the same against a stone, or sharpening medium which causes the removal of the softer metal and exposes the hard metal cutting edge.

PRECISION INTERPUPILLARY AND BRIDGE MEASURE.—W. H. OLDACH, c/o The Seadron Optical Co., 23 Central Ave., Panama, Panama. The invention relates to optician's gages used in the measurements for the fitting of frames for nose glasses or spectacles, the principal object being to produce an optical gage in rule form in which an interpupillary measure and a bridge measure are combined in rule form.

HACKSAW.—G. T. PARSLEY, 692 B St., Ashland, Oregon. The particular object of the invention is to provide a hacksaw in which the blade may be changed with the greatest ease and in which the angle of the blade relative to the frame may be adjusted by merely pressing on a spring, whereby the tension of the blade is released and the same may be rotated in the frame to any desired degree.

WRENCH.—J. A. JOHNSON, c/o America Hotel, 47th St., near Broadway, New York, N. Y. The object of the invention is to provide a wrench of simple and durable construction, reliable in operation, easily and readily adjusted, and adapted to exert a powerful gripping action. The wrench presents a substantially unitary structure, which may be easily disassembled for replacement or repair.

Heating and Lighting

HEATING APPARATUS.—M. P. HATCHETT, Box 395, Tishomingo, Okla. The invention has for its object to provide an apparatus especially adapted for utilizing to the best advantage the heating capacity of an open grate, wherein cold air is drawn from the outside of the building, heated by the open fire and distributed to the room at the upper portion thereof, to heat all parts of the room, and the upper rooms of the building.

FURNACE.—G. L. PERRINE, c/o Sanford House, Excelsior Springs, Mo. The invention has for its object to provide a furnace wherein a central grate is provided and a fuel support encircling the grate, together with means for supplying air at the grate and to the combustion chamber above the grate, by means of an air dome, to equalize the pressure above the grate and to provide for a perfect combustion of the fuel.

GAS LIGHTER.—C. F. LARSEN, 916 E. 62nd St., Chicago, Ill. One of the objects of the invention is to provide a gas-lighter in which the striking element and a cooperative pyrophoric element are encased, and consequently protected from the action of grease, oil, dirt and other foreign matter that might detrimentally affect the operation of the device. A further object is to provide a device whereby the pyrophoric element may be readily replaced.

Machines and Mechanical Devices

MEASURING DEVICE.—F. W. HUTCHINS, Box 775, Yama, Ariz. The prime object of this invention is to provide a simple means by which groceries such as coffee, dried beans, dried peas, sugar, rice, etc., can be measured instead of weighed, a scale on the outside of the machine indicating the weight of the amount measured. A further object is to provide a device which does not require the careful balancing of scales, but cuts off the desired quantity from a large amount, without error.

ATTACHMENT FOR WIPERS OR SQUEEGEES.—A. WENGER, 432 Broadway, Bayonne, N. J. The invention relates to wiper strips which are particularly designed for use in connection with members of the kind employed in connection with floor oiling machines. The invention is especially designed for use in connection with felt strips for the purpose of giving them a resilient backing to insure proper contact throughout their length with the surface to be wiped.

MACHINE FOR CASTING CURVED STEREOTYPE PLATES.—C. WINKLER, Berne, Switzerland. The object of the invention is to provide an inclined mold for casting curved stereotype plates. The construction is such that when the mold is opened its lower edge is moved in such a curve that the cast plate swings about its top edge, which is kept in engagement with the mold core, and the mold will be tilted with the plate, and thus release the matrix adhering to the plate.

CUTTING ATTACHMENT FOR TUBE-FORMING MACHINE.—D. E. E. ROLAND, 567 Martin St., Roxboro, Philadelphia, Pa. This patent relates to the making of drums or barrels from paper tubes. The machine provides a cutter on a carriage and swingable to engage the tube and travel with the same. Under successive operations the tube is cut into exact lengths for the making of the barrels, automatic means being provided for throwing the cutter into and out of action and returning the carriage after each forward movement.

LET-OFF MECHANISM FOR LOOMS.—R. GLACER, 46 Zabriskie St., Haledon, N. J. The invention has particular reference to tensioning devices for the warp beams of looms. The invention contemplates broadly the provision of an automatic let-off mechanism which operates to insure a constant and even tension of the warp threads under all working conditions, irrespective of the weight of the material which is being operated upon.

PRESS.—W. G. KENDALL, 118 Market St., Newark, N. J. The object is to provide a press more especially designed for forming powder puffs. Another object is to provide a press which permits of turning out a large number of powder puffs, or similar articles, accurately and securely united, in a comparatively short time without requiring the use of high skilled labor.

MACHINES FOR REMOVING THE STALKS FROM FRUITS.—P. O. NAVARRE, 56 Avenue de Chatillon, Paris, France. The object of the invention is to provide an automatic machine for removing the stalks from cherries and other fruit. The machine comprises a system for removing the stalks from the bunches, and from non-connected cherries and other fruits. In the case of cherries when the fruit has been freed from the stalk, it falls into a hopper which leads to a machine for removing the stones.

FLOWING DEVICE FOR WELLS.—L. FRIEDMAN and D. WALLACE, address L. Friedman, Muncie, Ind. The invention particularly relates to devices adapted to promote the flow of oil or water from wells when insufficient pressure exists to cause flow through the well casing. The invention aims to provide a simple, inexpensive device singularly free of valves and other complicated parts, and one which may be easily introduced into or removed from the well.

ATTACHMENT FOR REFRIGERATING MACHINES.—J. H. MCCRARY and C. A. RUSS, c/o Public Service Co., Tulsa, Okla. The invention has for its object to provide a device by means of which the percentage of ammonia in the liquid and in an absorption refrigerating machine may be ascertained at any time, and suitable for use for ascertaining the percentage of liquid in any solution where a difference in specific gravity exists.

COMPUTING MACHINE.—W. E. ROYSTER, JR., Henderson, Ky. Among the objects is to provide a machine wherein a number of series of chart rollers is mounted to revolve about a common axis and to rotate on their own axis, the rollers of each series bearing complementary data, and wherein means is provided for bringing the rollers in succession to observing position and for locking the moving means with the said rollers, and wherein an indicating roller is provided bearing matter cooperating with the matter on the chart rollers, and controlled by the revolution of the chart rollers.

GENERATOR AND MOTOR SUPPORT.—A. N. SAMMARONE, Akron, Ohio. One of the foremost objects of the invention is to provide pressed metal feet, to be suitably secured to the frame of a generator or motor to constitute the supporting base therefore, the feet being so shaped as to constitute an ample base and also to particularly follow the contour of an adjacent part of the generator and thus constitute an attached base in combination therewith.

STOP-MOTION FOR KNITTING MACHINES.—J. SCHULTZ, 963 Prospect Ave., Bronx, New York. The invention has for its object to provide a drop-motion for machines of the reciprocating-carriage type and arranged to automatically stop the machine on the yarn running out or in case the yarn breaks or a knot is in the yarn. Another object is to provide a stop-motion which is exceedingly sensitive and to allow of adjustment, according to the strength of the yarn used.

VENDING MACHINE.—O. J. HOTALING, c/o American News Vender Corp., 67 Tompkins St., E. Orange, N. J. One of the principal objects of the invention is to provide an extremely simple and inexpensive delivery mechanism for vending machines which comprises relatively few working parts which are assembled and related in such manner as to positively feed by gravity the articles to be dispensed. A further object is to provide a delivery mechanism normally locked against operation, and coin-actuated mechanism for releasing the same.

SHUTTLE DRIVER FOR SEWING MACHINES.—N. MCKENZIE, 404 Ashmun St., Sault Ste. Marie, Mich. The invention relates to shuttle drivers for sewing machines such as are used in the shoe-making art. The particular object is to provide a shuttle driver of a strength consistent with the strength of the other parts of the machine, and one in which it is impossible to assemble the parts of the driver other than the correct way, and to so construct the device that the wear may be instantly taken up without disassembling any part of the machine.

TYPEWRITING MACHINE.—P. STEINKRAUS, 317 E. 31st St., New York, N. Y. This invention relates to embossing and penetrating typewriter machines for use by the blind, whereby the blind as well as seeing persons are enabled to produce each character in both Braille cells and type and hence enable both to read the characters produced on the sheet of paper. Another object is to permit the invention to be applied to the various styles of typewriting machines without requiring entire reconstruction thereof.

LIGHT ATTACHMENT FOR SEWING MACHINES.—A. T. BARTOLINI, 1705 Taylor Ave., Bronx, N. Y. The object of the invention is to provide a light attachment for sewing machines, arranged to permit the user to conveniently place the light in position on the machine arm, whereby the rays may be thrown in any direction for properly illuminating the work. The device may be attached without requiring changes in the construction of the machine.

DEEP-SEA SALVAGE APPARATUS.—A. E. LEMON, Sault Ste. Marie, Mich. Among the objects of the invention is to permit of maintaining a practically normal air pressure within the apparatus, irrespective of the depth, thus enabling the occupants to work without danger. Another object is to enable the operator to fasten grappling devices to a sunken vessel, and also to move the apparatus along the sea bottom for locating vessels.

DEVICE FOR INTERLEAVING SHEETS PRINTED IN CYLINDER FLAT-BED MACHINES.—C. WINKLER, Berne, Switzerland. The invention comprises, in combination with a reciprocation delivery device, normally closed grippers adapted to move backward and forward with said delivery device, a portable pile table for interleaving sheets provided just outside the range of the reciprocating delivery device, and tappets to open said grippers at the ends of the backward and forward strokes.

WASHING MACHINE.—S. PATT, 72 Vine St., Willoughby, Ohio. This invention has for an object to provide a form of washboard or rubber which may be adjusted to properly rub different kinds of clothes so as to provide a cleaning action without injury to the clothes. A further object is to provide a construction in which the water is forced through the clothes while the clothes are being rubbed.

PUMP JACK.—W. G. JENSEN, 1154 Keeler Ave., Bartlesville, Okla. The object is to provide a pump jack of simple and durable construction, reliable in operation and easy to install, which is adapted to the requirements of various characters of wells and which imparts a pure rectilinear motion to the polish rod of the pump so as to operate the rod with the minimum wear on the stuffing boxes and associated structure.

METHOD OF AND MEANS FOR BLOCKING OR CORRUGATING HEADERS FOR STEAM BOILERS.—R. REES, Kapunda, South Australia, Australia. This method consists in assembling a number of specially-shaped blocks and an intermediate draw-bar in an open-topped box to form, as it were, a core, inserting the assembled blocks and the draw-bar in a heated tube, then pressing the same between top and bottom dies, and then withdrawing the draw-bar and the blocks.

RIVET-FEEDING MECHANISM.—A. F. RENAUD, c/o The Renaud Co., Cincinnati, Ohio. The primary object of the invention is to provide a rivet feeding mechanism for association with a punch press and operable thereby for automatically feeding and presenting the rivets in proper position adjacent to the bolster plate of the press to receive the openings in strips previously punched therein by the press.

MEANS FOR FEEDING CANS.—F. B. DONNELLAN, 106 6th St., San Francisco, Calif. The invention relates in general to cooking retorts of high pressure steam for cooking canned food stuffs, and has reference more particularly to mechanism for introducing the cans into and withdrawing them from the retort, the retort being equipped with two openings, one for the introduction and one for the withdrawal of the cans.

WELL ROD SOCKET.—J. A. DAY, Section 14, Oilfields, Calif. The object of the invention is to provide means for gripping a rod having an enlarged end, by means of a tube adapted to loosely fit on the enlarged end and a plurality of cooperat-

ing spades pivotally suspended within the wall of the tube, the tips of the spades normally extending into the tube but being adapted to temporarily recede within the wall when passed by the enlarged end of the rod.

Medical Devices

DENTAL IMPRESSION CUP.—J. K. NORTHWOOD, 1420 New York Ave., Washington, D. C. A purpose of the invention is to provide a cup which can be contracted to cause the impression material to be firmly compressed against the sides of a jaw, thereby securing a perfect impression of the jaw. Furthermore the companion jaws are removably associated with the body of the cup to permit of substituting jaws of any desired contour to suit the human jaws.

SURGICAL INSTRUMENT.—A. SAPERSTEIN, 185 Amboy St., Brooklyn, N. Y. The invention relates to an instrument for use in connection with the removal of tonsils. An object is to provide a construction by means of which the tonsil may be removed from the mouth of the patient without any danger of its being lodged in the throat, aside from the fact that a severance of the tissue is permitted in a rapid manner, and with the danger of hemorrhage resulting being reduced to a minimum.

Musical Devices

AUTOMATIC STOPPING DEVICE FOR PHONOGRAPHS.—W. T. LAKIN, Treasury Department, Internal Revenue Service, Cumberland, Md. The invention has for its object to provide a device adapted to be arranged beneath the turntable of a phonograph, and having operative-braking mechanism for engaging the turntable to stop the turning, and means for restraining the operation of the braking means, arranged to be tripped by the reproducer when it has reached a point where it is desired to stop.

AUTOMATIC STOP FOR PHONOGRAPHS.—B. W. GARDNER, Box 1389, Memphis, Tenn. The invention relates to a stopping mechanism adapted to automatically stop or cut off a phonograph when the stylus has reached the end of the record grooving. Another object is to provide a device that will be quite simple, and positive in action, and one that requires no knowledge of operating a phonograph to obtain the desired results.

AUTOMATIC ELECTRICAL PERCUSSION MUSICAL INSTRUMENT. — J. WALKER, 341 E. 149th St., Bronx, N. Y. The object is to provide a musical instrument more especially designed as a toy or a baby piano, and arranged to enable a child to readily play the instrument either by actuating keys or by the use of a perforated note sheet and the turning of a crank. Another object is to provide a musical instrument which can be cheaply manufactured and is not liable to get easily out of order.

Prime Movers and Their Accessories

TOY ADDING MACHINE.—A. E. LARSON, c/o Elmer Larson, 2846 Lyndale St., Chicago, Ill. An object of this invention is to provide a simple toy which resembles a regular adding machine and which will accurately add small numbers. A further object is to provide a device of this type having means for quickly resetting the machine back to zero. The device will add any amount up to ten with each operation.

EDUCATIONAL TOY.—J. M. BRANDVEIN, 13 W. 24th St., New York, N. Y. The primary object of the invention is to provide a toy calculator which will aid in teaching children the multiplication tables. A further object is to provide a toy wherein only one problem is exposed at a time and the answer to that problem is normally concealed, and to provide means for exposing the answer, after the child has solved or attempted to solve the problem.

WALKING TOY.—I. A. ROMMER, 273 Van Senderen Ave., Brooklyn, N. Y. The invention relates to walking toys, such as dolls, animal figures, and the like, and more particularly to means for pivotally attaching the legs in a manner so that as one leg moves forwardly the other is moved backward. The general object is to provide pivotal means for the legs, linking up one leg with the other to give the correlated movements.

VALVE-GRINDING TUBE.—A. LOVELESS, Box 546, 1115 E. Market St., Aberdeen, Wash. The invention relates to tools for grinding the valves of internal combustion engines, the purpose being the provision of a tool which is constructed to permit of its being supported directly on the engine and readily operated therefrom. The tool is adjustable to vary the pressure exerted on the valve during the grinding.

Railways and Their Accessories

RAILWAY-CAR DOOR. — W. SALMON, 266 Farrington Ave., St. Paul, Minn. This invention provides for fitting the door either tightly or loose to afford ventilation. Means for regulating the lateral movement of the door into the door opening is arranged at each of the four corners and each assemblage comprises a picture on the door frame with a laterally-inclined guide slot in which runs a small wheel, carried by a lever on the door and operable by a handle at the exterior. The illustration at the right shows a vertical section of one of the fixtures. (See Fig. 5.)

CAR STEP.—C. E. PORTER, R. F. D. No. 1, Neville Station, Corapolis, Pa. The invention relates to a device which can be substituted for the usual form of stirrup step used on freight cars. An object is to provide a device which can either serve as a step to the car, or serve as a guard, and be quickly attached to the ordinary form of stirrup step, effectively preventing the foot of a brakeman or trainman from slipping through the stirrup step, and thereby act as a safety device.

AIR-BRAKE ATTACHMENT. — A. P. SALE, Room 203, Moore Bldg., San Antonio, Texas. The object of the invention is to provide a valve and operating mechanism therefor which may be interposed in an air-brake pipe and cause the air pipe to be opened for applying the air brakes to the car with which the device may be associated whenever said car should become derailed.

RAILWAY TRACK.—J. LE R. COSBY, 101 N. 12th St., Albuquerque, N. M. The object of this invention is to provide a tie constructed of a single piece of metal and which is so organized with the rail as to obviate the necessity of bolts, spikes, screws, wedges or similar fastening devices, and yet at the same time positively support and engage the rails in such a manner as to preclude any possibility of spreading or creeping.

SEAT.—H. S. ROBERTS, 809 4th Ave., Albany, Ala. The invention relates more particularly to seats for installation in locomotive cabs. An object is to provide a seat possessing great durability under severe usage and yet be extremely easy riding. A further object is to produce a seat which can be easily installed or taken down, and can be readily folded to occupy little space when not in use.

Pertaining to Recreation

FISHING ROD.—J. C. CALDWELL, c/o General Delivery, Miami, Fla. The invention has for its object to provide a rod wherein the handle is so constructed that a portion may be reciprocated whereby the line may be wound up on the reel and wherein means is provided, controlled by the winding up of the line, for laying the line on the reel and means for braking the operation of the reel during the unwinding.

GAME APPARATUS.—A. ALEXANDER, 315 20th St., Brooklyn, N. Y. The general object of the invention is to provide a game apparatus in which stationary shooters and movable targets are employed, in such manner that a large number of players may engage in a contest and in which ball targets or equivalent target elements are dislodged from a traveling support, accumulated dislodged targets factoring in determining the winner of the game.

Pertaining to Vehicles

TIRE DEFLATING SIGNAL.—F. D. HARMAN, c/o Seattle Power Plant, Cedar Falls, Wash. The invention has reference more particularly to an electric signal adapted to indicate deflation in a pneumatic vehicle tire. The object is to provide a device the spring action of which, when the tire becomes deflated, will cause a current to pass through the circuit and ring a bell, or light an electric light, to warn the operator. The adjustment of the device will not be disturbed when the tire is changed. (See Fig. 6.)

TRANSMISSION LIMIT FOR POWER SHAFTS.—J. C. SNYDER, Box 270, Frostburg, Md. The object is to provide a transmission adapted for automobiles, particularly such as the Ford type, which may be separately associated with a power shaft, and operated in conjunction with another transmission unit connected with the same shaft in such manner that additional driving speed of the shafting may be had.

ANTISKID CHAIN ANCHOR.—C. S. WEIMAR, 26 Caspian St., Elizabeth, N. J. One of the principal objects of the invention is to construct a simple and effective retaining hook which positively prevents the accidental displacement of the chain. Another object resides in the provision of a retaining hook which admits of the ready application or removal of the chain from the wheel. The device is durable and inexpensive to produce.

CLINCHER-TIRE REMOVER AND REPLACER.—F. E. WAFER, 7314 Kenwood Ave., Chicago, Ill. An object of the invention is to provide a device to be used in removing and replacing clincher tires, and having means for engaging such a tire to permit the same being removed from the rim of a wheel

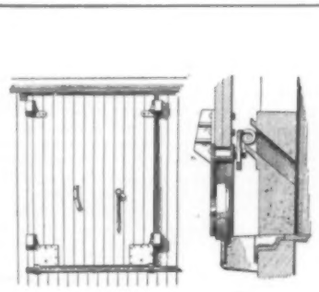


Fig. 5: W. Salmon's improved door for railroad freight cars

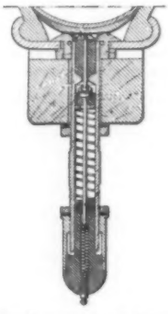


Fig. 6: A signal to warn the driver of a flat tire, invented by F. D. Harman

connection whereby the device may be easily and quickly secured upon the valve stem in such way that the gauge may be faced in the desired direction and accidental displacement rendered difficult.

PEDAL LOCK.—C. D. BAILEY, 12 E. Charles St., Massillon, Ohio. The invention relates to locks especially adapted for use in connection with Ford automobiles. The invention embodies a lock having means whereby the clutch pedal of a planetary transmission may be held in its intermediate or neutral position when it is desired to temporarily break the engagement between the engine and the drive wheel. A further object is to provide means whereby the operator is prevented from accidentally moving the pedal from high speed to low speed.

TRUCK TIRE PUMP.—G. J. SPOHRER, 46 Eppert St., East Orange, N. J. The invention has for its object the provision of an air compressor designed to be mounted on the transmission casing of the power plant of an automotive vehicle and operatively connected to be driven from the power plant for supplying a source of pneumatic power or for inflating tires.

BEARING SCRAPER.—A. PATIGIAN, 521 McHenry Ave., Modesto, Calif. Among the objects of the invention is to provide a device for scraping bearings of automobiles, wherein the scraper is power-controlled, is easy to handle, and may be introduced into confined spaces, and the cutter is interchangeable to permit of various forms of cutters being used.

LOCK FOR RADIATOR CAPS.—F. N. BROWN, Jr., 407 Mills Bldg., El Paso, Texas. The object of the invention is to provide a device which is of simple and durable construction, which is adapted for use with various standard makes of radiator caps, and which is effective to secure the cap and preclude accidental displacement of the cap from the filling neck except by deliberate manipulation.

DEMOUNTABLE RIM.—R. H. PIERCE and G. A. ANDERSON, c/o R. H. Pierce, Eugene, Oregon. Among the objects of the invention is to provide a simple positive locking device for attaching rims to vehicle wheels, and to provide a device which will facilitate the changing of rims, and which may be adjusted for wear, the use of bolted-on lugs being eliminated, and a strong and comparatively inexpensive rim being provided.

LUBRICATOR.—C. C. CRISPEN, 708 No. 17th St., Harrisburg, Pa. The purpose of this invention is the provision of a lubricator in which wicks are employed in conjunction with an oil reservoir in such manner as to effect the automatic and uniform distribution of the oil to elements remote from the container, the invention being especially adapted for the lubrication of steering bolts, spring bolts, and similar parts of a vehicle chassis.

TIMER.—D. S. HAYNES, Louisville, Ky. An object of the invention is to provide a timer for use on automotive vehicles, which is so constructed that the lead wires will not in any way interfere with the moving parts of the power plant. A further object is the construction of a timer of the Ford type which will permit the use of a smaller cam thus reducing the wear on the cam surface and the parts contacting therewith.

TRANSMISSION MECHANISM.—H. L. APPLERAUM, 958 St. Paul St., Denver, Colo. The purpose of this invention is the provision of a transmission mechanism by means of which the ratio of rational speed in either direction between driving and driven elements can be gradually varied to a selected degree, the device is capable of transmitting any and all speeds.

ANTISKIDDING DEVICE.—F. W. FRENCH, 3027 Logan St., Fruitvale, Calif. The object of the invention is to provide a simple, cheap and durable anti-skidding device for automobile wheels which can be readily attached by any one regardless of his skill, and under any conditions. The device consists of a plurality of chain and a spring means associated therewith which may be separately attached and conveniently secured to any part of a tire.

RADIUM EMERGENCY LIGHT.—W. S. NELSON, 311 Illinois St., Vallejo, Calif. Among the objects of the invention is to provide a light which in case an automobile battery gives out or the wires become disconnected, although not very brilliant, will make it possible for the driver to continue travel to the nearest repair station, and will furnish sufficient light to prevent accidents, and comply with police regulations.

TIRE ALARM AND GAUGE.—W. A. HARRIS, c/o R. S. Conrad Co., Greenville, S. C. The invention aims to provide a combined gauge and low pressure alarm for pneumatic tires, and more particularly a form of

Designs

DESIGN FOR TOMBSTONE.—C. JOHNSON, 511 Rodney Ave., Portland, Ore.

DESIGN FOR A STATUETTE.—G. D. CLARDY, R. F. D. 1., 11 Rowland Ave., Allwood, N. J.

DESIGN FOR A DOLL.—M. F. LOPEZ, 214 W. 62nd St., Los Angeles, Calif.

DESIGN FOR A COMBINED NUT-CRACKER AND BOTTLE OPENER.—B. LUTSKY, 67 Herze St., Brooklyn, N. Y.

DESIGN FOR A FLAG OR BANNER.—D. W. CHANDLER, c/o Annin & Co., 99 Fulton St., New York, N. Y.

DESIGN FOR A BRUSH.—A. L. KOHN, 341 Madison Ave., New York, N. Y.

DESIGN FOR A BOY'S SUIT.—F. MACKAY, Perry Ave., Norwalk, Conn.

DESIGN FOR A CRADLE CHAIR.—W. F. SILLIMAN, 20 So. 18th St., Philadelphia, Pa.

DESIGN FOR AN ICELESS REFRIGERATOR.—G. A. AMATO, c/o Usnoice Refrigerating Co., 110 W. 40th St., New York, N. Y.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Speeding Up Tent-Stake Driving

THE "big tops" are going up faster since a San Francisco circus-supply concern designed a special truck body equipped with a power stake-driving device. Its efficiency in erecting tents may be judged from the fact that the power hammer will drive five tent-stakes in the time it ordinarily takes four sledge-slingers to drive one. The stake-driver gets its power directly from the main drive-shaft of the truck. The hammer operates in a cylinder of steel. By means of a friction clutch which is engaged at will by the operator it is raised into striking position. Simply disengaging the clutch permits gravity to take care of the blow. It is geared fast enough to allow an experienced workman to strike 30 blows a minute with a force ranging from 300 to 1000 pounds.

In addition to the stake-driving feature there is a vertical gypsy-head that is also connected to the main drive-shaft, which is used in connection with block-and-tackle in raising centre and quarter poles of tents. This equipment enables the standard truck to handle the work formerly done by a team of horses that had to be picked up on the job. There are various compartments on both sides of the truck for tools, stakes, and the workman's clothes. Two powerful search-lights in addition to the truck's regular equipment make it unnecessary to call time on account of darkness.

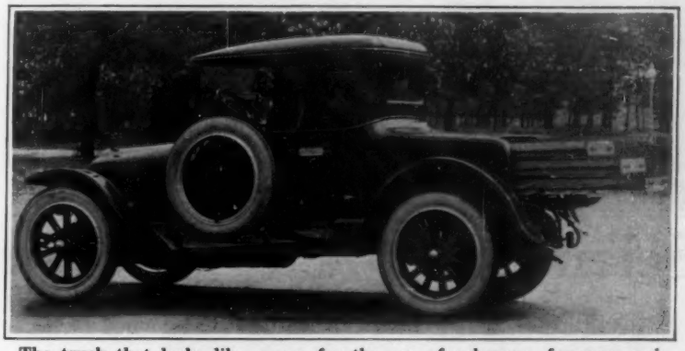
A Bus Endurance Record

BY completing a run of 20,000 miles in 61 days, a motor bus operating in Southern California, is said to have established a record for mileage and endurance never before equalled by automotive equipment. The bus that made this record is running between Los Angeles and Redlands. The exact distance is 72.2 miles and the two months' mileage of 20,000 miles means over 69 round trips per month and uninterrupted running averaging nearly two and one-fourth round trips a day. Only two drivers alternated at the wheel for the entire period. Number 61 carries 21 passengers and driver, and has been in continuous operation since April, 1920. Like all stage equipment operated by this company, it is powered with a 50-horsepower motor on a 2-ton chassis.

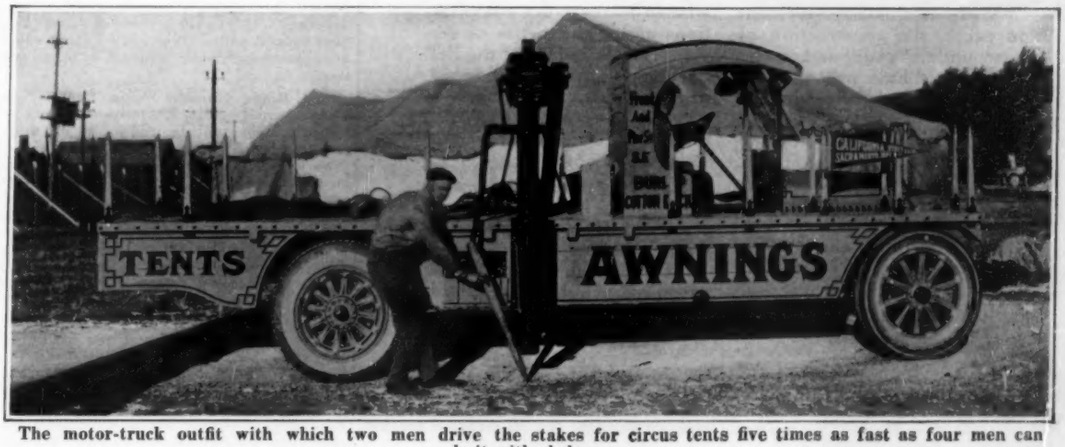
California motor-bus that covered 20,000 miles in 61 days of regular running

New Type of Commercial Car for Salesmen

TO meet the need of salesmen and men whose duties make it necessary for them to travel over scattered and sparsely settled territory, a motor-truck-manufacturing company has placed on the market a new type known as the "Business" car. At first glance the new model gives the impression that the company has returned to the passenger car field, but such is not the case. While the business car has the appearance of a passenger model it is of truck construction, combining the rugged, durable qualities of a speed-wagon type of truck with the comfort and trim appearance of a touring car. The business car makes an appeal to the salesman who covers a territory made up largely of small towns, as it enables him to double and sometimes treble his calls per day. The customer in the one-train-a-day town can be called on more frequently, since the business car makes it unnecessary to devote an entire day to one customer. Between-train losses of time are eliminated. But the car has a much more extended use than that to which it is put by salesmen. It fills a long-felt want of foremen and superintendents of utility companies who are doing extension work in several localities at one time; of mining, oil and logging companies whose men must get about in rough country in all weather; of cattlemen with extensive ranches; of road contractors, inspectors, and insurance men; of sugar and cotton growers with scattered plantations.



The truck that looks like a car, for the use of salesmen, foremen, and others whose business is everywhere at once



The motor-truck outfit with which two men drive the stakes for circus tents five times as fast as four men can do it with sledges

These uses given above are just a few of its possibilities. The complete list would include every sort of business man who needs a means of transportation of his own and absolutely reliable to cover scattered territory. A great many men who have used automobiles in the past for this sort of service also operate trucks in their business over the same territory. They know that good trucks, as a rule, outlast their automobiles by years. The business car is a development of the standard taxicab chassis with seating capacity for two persons. Without sacrifice of strength the body affords the driver every comfort and convenience. A permanent top gives protection against the inclemencies of the weather. There is ample room for baggage back of the seat, and the spacious rear compartment may be fitted to accommodate whatever business paraphernalia the user may have to carry.

Heavy Trucks a National Problem

THE heavy motor truck is perhaps the most formidable problem confronting the highway engineer of today. State and federal officials are at a loss to know how to deal with it. Some state officials are taking what they consider the easiest way out and allowing only certain-sized trucks to operate in the state; other states are attempting to build roads that will withstand the assaults of these vehicles. In all cases it is looked upon as a problem. Few persons deny the economic value of the heavy motor truck to the operator, but at the same time many are not convinced that it is of such general value as to warrant expenditure of huge sums for road construction and maintenance so as to allow its operation.

The Bureau of Public Roads of the United States Department of Agriculture, in its annual report, recognizes this condition and suggests either proper regulation of these vehicles, or else restriction of their use to certain highways, built, of course to carry them. The Bureau declares that the problem grows more important each year.

"Whether the operation of the heavier vehicles," says the report, "shall be restricted to a class of roads especially designed to accommodate them, or whether all roads shall be strengthened for unrestricted use, or whether the third alternative shall be adopted and the operation of the heavier trucks prohibited, will depend upon the relation which is found to exist between reduced operating and increased cost of road construction."

2400 telephone wires in a cable little larger than a man's wrist

Science keeps down costs

When the Bell System installed its first successful telephone cable, fifty wires was the largest number that could be operated in a single cable without "cross-talk" and other interference. Today it would require 48 cables of the original type to accommodate the number of wires often operated in one cable.

Without this improvement in cable, the construction of new underground and aerial lines would have cost the Bell System upwards of a hundred million dollars more than has actually been spent. In addition, the cost of maintenance would have been greater by eighteen million dollars a year. These economies in the Bell System mean a saving in telephone rates to each individual subscriber.

In all branches of telephone practice science has similarly contributed to economy. Even in such a comparatively small item as switchboard cords, improvements have reduced the cost of renewal by four million dollars a year.

Every new telephone added to the Bell System increases the usefulness of *all* telephones, but this multiplication tends likewise to increase the complications and the expense of service. The scientists of the Bell System, to offset this tendency, are constantly called upon to develop new devices which simplify complications and keep down costs.

By virtue of a united system the benefits of these improvements are shared by all subscribers—and the nation is provided with the best and cheapest telephone service in the world.

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Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

A Magazine of Identification.—A bimonthly magazine entitled *Dactylography* is announced, to deal with the detection and judicial investigation of crime, particularly by means of finger-prints, foot-prints, blood smears, and deformities.

Exploration of the Magdalena.—Colombia's Department of Public Works has contracted with a foreign company for a scientific exploration of the Magdalena, the heart of her transportation. It will be determined how best to keep the river in good condition for freight and passenger service.

Prehistoric Monsters in Spain.—On a farm at Retortello, Spain, have been found large deposits of animal fossils reported as aquatic. One, complete, measures 76 feet; another is a detached head measuring about 36 feet. Scientists have inspected the find and regard it as most important.

High-Grade Paper from Swiss Chard.—At Yakima, Washington, paper has been made from the stems and leaves of Swiss chard. The product contains 48 per cent cellulose, and is said to be equal to fine Japanese parchment and to be suitable for drawing, engraved cards, and book paper. Swiss chard matures from seed in three months.

Bulb Culture in the Schools.—A Hollander who recently became a resident of New York, impressed by the enthusiastic response of our public schools to the School Garden Association's call for bulb culture, has made a gift to the schools of 32,000 Von Sion daffodil bulbs. Narcissus culture under school auspices is to be rewarded by silver and bronze medals.

Mt. Blanc Shrinks Nine Feet.—New measurements of Mt. Blanc by scientists reveal the fact that instead of being 4,810 meters in height it stretches but 4,807 meters toward the skies. While some authorities hold that the greater accuracy of our present instruments is responsible for this apparent shrinkage, others believe the loss to be actual. From the brow of the mighty mountain rises a snow cap at least a hundred feet in thickness, and in view of the unusual heat of the past summer it is not inconceivable that nine feet of this cap should have melted away.

The Effects of Rain on Soil.—The University of Illinois has constructed 16 soil bins of concrete, each a rod square and 8 feet deep, and filled them with natural earth. Rainwater seeps through this soil, and such of it as escapes from outlets at the base of the bins is analyzed. These experiments may determine whether rainfall carries off any of the chief soil elements, and will provide data as to the effect on the soil of fertilization, crop removals and leaching, with particular respect to nitrogen and other elements in a 4-year rotation of wheat, corn, oats and clover.

The Conservation of Pulp Wood.—The national forests of Alaska contain about a hundred million cords of pulp wood, not more than enough to supply our needs for 17 years. With sound management these forests might yield 2,000,000 cords annually for all time. The Government is selling, under wise restrictions, several million cords to paper manufacturers, but mills must be built and hydro-electric power generated before this pulp can reach the market. Even then it can only relieve to some extent existing needs. This protection from reckless exploitation should be followed by scientific replanting.

Radium by King's Messenger.—Prof. Soddy of Oxford University, traveling as a King's messenger, safely conveyed two grams of radium, valued at more than $300,000, from Czechoslovakia to London. It is said to be the most valuable shipment of radium yet made, and it will be used at Oxford for experimental purposes. It is the product of the noted Joachimsthal pitchblende deposits, a monopoly of these having been secured by the Imperial and Foreign Corporation of London under an agreement with the Czechoslovak Government. The present consignment is a loan, returnable to the government in fifteen years.

Domestic Agar-Agar.—From researches made by the late Dr. I. A. Field, it appears that the common Irish moss of the New England coast and several red seaweeds of the Pacific coast yield agar of equal or superior quality to that from Oriental sources. Carageenin, the gelatinous product of Irish moss, long used in sizing soaps, paints, dyes, oils and medicines, is found excellent for packing fish too soft to keep their shape in cans. Agar is of the greatest importance as a solidifying agent in culture media; since its solutions remain solid at higher temperatures than those of gelatin, it is essential to medical laboratories and hospitals.

Wrangell Island Reached.—The vanguard of the Stefansson expedition, consisting of four whites and four Eskimos with Commander Crawford as leader, reached Wrangell Island late last summer, with conditions very favorable. Plenty of driftwood was found with which to build shelters and maintain fires, augguring comfort for the winter which the party intends to spend on the island. Wrangell is a most popular resort for polar bears, and sufficient animal food seems assured. Stefansson will join the party later and expects to spend several years in the Arctic, mapping the undefined boundaries of Wrangell Island and collecting other geographic and geologic data.

A Long-Dead Lady in a Law Suit.—"La Belle Ferronière," as painted by Leonardo, is again adventuring in the public eye. The Kansas City Art Institute was about to pay half a million dollars for the lady when a prominent dealer pronounced her false, stating that the real La Belle was in the Louvre. Suit for this amount has been brought against him by the owner of the picture in dispute. It is possible that both pictures are from the hand of Leonardo; but another complication is introduced by Paul Durrieu, who affirms that, while the true La Belle Ferronière is indeed in the Louvre, it is not the picture hung under that name, but one known only as "No. 1605," an exchange having been made by mistake. A comparison of the 400-year-old finger prints found on authentic Leonardos with those on the Hahn picture may decide the suit.

Measuring Life Processes.—Prof. Osterhout, investigating fundamental life processes at Harvard, has made discoveries that may throw light upon human injuries and recoveries. Experiments with Laminaria, a common brown kelp, show that its resistance to an electrical current provides a definite index to its normal condition of vitality. Injury to the plant decreases its electrical resistance; by measuring this resistance under varying circumstances, curves may be plotted to demonstrate the exact effects of different kinds of injuries, the extent and time of recovery, and the manner in which the plant dies. Thus some of the mathematical exactitude of chemistry and physics is made available in the intricate field of biology. The method not only suggests that fundamental life processes obey the laws of chemical dynamics, but promises to reveal the underlying mechanism of these processes.

Arctic Exploration to Finance Itself.—Undaunted by disaster, Christian Leden will return to the Arctic, taking with him geologists and botanists to found a scientific colony that will be in constant communication with the outside world. He expects to locate vast stores of minerals, to learn much of plant life, and to excavate among strange stone ruins evidently built by white men—possibly by the Vikings. Leden believes there is sufficient wealth in this region to attract white settlers and, incidentally, that the present expedition may finance itself by the export of oils and other products of the unknown territory north of Hudson Bay. Christian Leden said some striking things about the possibilities of the future. The cold is not unbearable to the properly-clothed person of average health, and he believes the rich oil and mineral lands above Hudson Bay will in coming years attract so many people that cities will spring up in that region. The whale, walrus and seal abound, and he plans to finance his expedition from these sources. The reindeer provides milk, meat and clothing, and the success of reindeer ranching is predicted. He lays great stress on the habitability of the north.

Civil Engineering Notes

Mystery of the Big Berthas.—Of twelve "Big Bertha" guns known to be in German possession, only two have been found. German professions of ignorance are not credited, and investigators may be sent to the sand dunes of the North Sea to find out if these formidable weapons are buried there with a view to their use in "the next war."

Milk by Tank Car.—Seventy-five per cent of the usual charges for hauling milk in cans is what a Pittsburgh dairy expects to save by using glass-lined tank cars of seamless plate steel. Each car mounts two tanks, and three cars do the work of seven of the old can-handling style. With attending cuts in labor and auto truck costs, the saving may reach $50,000 a year.

Railway Metals Damaged by Welding.—A decided weakening of steel T-rails has been found to be caused by attaching electric bonds to them by welding in connection with the development of a theft-proof rail bond for the Mexico City street-railway system. Some tests, described in the *Engineering News Record*, were made and indicate that drop-test results on rails with welded-on bonds are less than one-half as good as the results obtained with corresponding pieces of rail having no bonds attached.

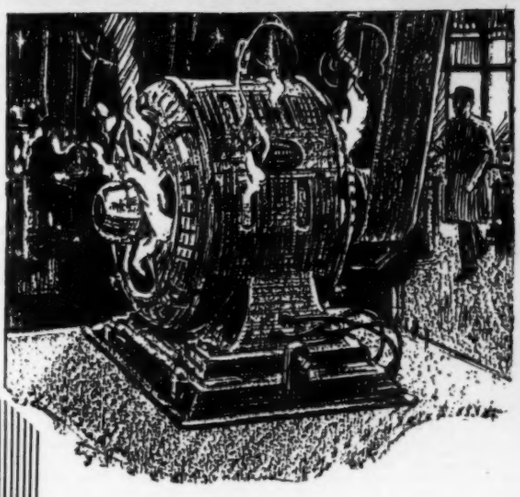
Windows as Fire Hazards.—The construction of fire-proof buildings is often made ineffectual by the ease with which fire is communicated from outside via the windows. For some years the insurance companies have been aware of this hazard; and it has been emphasized by several recent and rather disastrous fires which have been spread in this way to premises other than those primarily affected. In conjunction with the narrowness of city streets and shafts, the problem is a real one, and one which our engineers must ultimately solve. A severe loss has recently been suffered in Chicago from a fire which entered the windows of a large office building from the opposite side of an eighty-foot street.

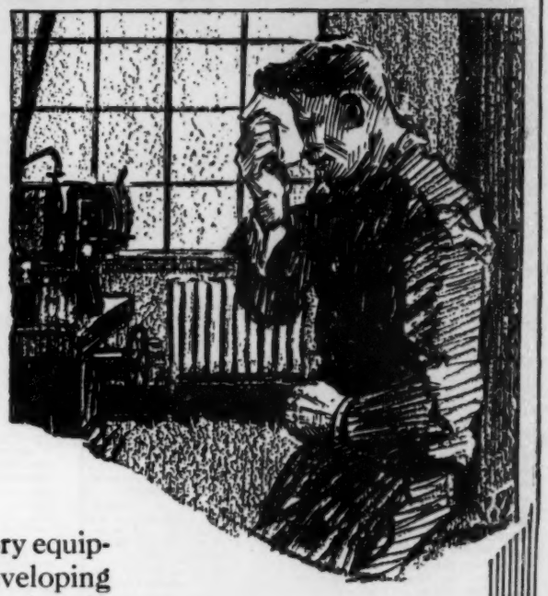
Automobile Tail Lights are the subject of discussion by railroad engineers to whom the red light stands by long tradition as an active danger signal rather than a mere caution. It is suggested that aside from the general principle involved, there is considerable actual confusion when roads and railroads run parallel, the tail lights under numerous conditions behaving much like a waving lantern. The automobilist has his own experience of confusion between tail lights and fixed lights marking excavations and other obstructions, and it seems to us that he might be willing to adopt a green signal to mark the location of his rear elevation in the dark. The use of the recently popularized "stop" signals would not be attacked, since these mean what they say—active danger to the car behind.

The Hooghly Bridge.—The report of the committee of engineers appointed by the Government of Bengal to advise with regard to the erection of a new bridge over the Hooghly River, recommends the cantilever or large span type of bridge, and the cost is estimated at two million pounds sterling, while it is expected that about three and a half years will be occupied in its construction. The new bridge, it is suggested, should be built on a site on a center line running from a point 630 ft. north of the center of the existing bridge, on the Calcutta side, to a point 580 ft. north of the center on the Howrah side. Provision has been made for three lines of vehicular traffic each way in addition to two lines of tramways. The total width of the bridge is recommended at 100 ft., allowing 18 ft. for two lines of tramways, 58 ft. for six lines of traffic, and 24 ft. for two footpaths.—*Indian Engineering.*

A Polish Canal Project.—The Paris *L'Information* learns that the Baltic-Black Sea Syndicate has conceived the idea of constructing a coal canal between Dantzig and Silesia. The authors of the project consider that the Polish riverways will constitute an important factor in the development of commerce between the East and West. The canal would require eight years to construct, and would cost 350 million gold francs. It would serve forty important towns and cross a mining and an industrial region, with branches to Posen and Warsaw. The goods to be transported would be principally coal, peat, timber, potatoes, grain, beetroot, iron ore and building materials. The canal would, it is anticipated, be of great importance in connection with the reconstruction of Russia, as it would provide a direct outlet to the markets of Southern Russia and Central Asia.

Overheating is Costly
In machine or man





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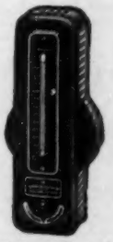

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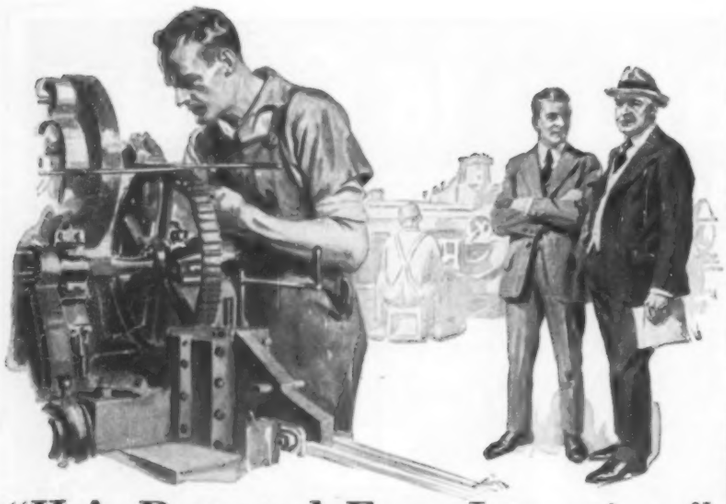

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Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Contributory Infringement.—Where the defendant made in the United States and shipped to Canada parts, there assembled into complete scales, including the patented cylinder, and there delivered to Canadian users, but no completed scale, or completed cylinder was ever shipped to Canada, defendant was not liable to a contributory infringement in this country to which a contribution can be made. (Computing Scale Co. vs. Toledo Computing Scale Co., Circuit Court of Appeals, Seventh Circuit, 279 F. 648).

Foreign Patent as Anticipation.—Whether or not a foreign patent is effective as an anticipation of a United States patent frequently constitutes a problem offering some difficulty. It was recently decided that a prior, foreign patent will not defeat an invention patented here, unless its description and drawings exhibit a substantial representation of the patented invention in full, in terms which would enable a person skilled in the art or science to which it appertains, without the necessity of making experiments, to practice the invention. (Permatit Co. vs. Harvey Laundry Co., Circuit Court of Appeals, Second Circuit, 279 F. 713).

Expiration of Trade-Mark With Patent; Unfair Competition.—An interesting case was recently decided by the Circuit Court of Appeals, First Circuit, in the action of O'Sullivan Rubber Co., Inc., vs. Genuine Rubber Co. (279 G., 972). The court again expresses the well-known legal proposition that on expiration of a patent the exclusive right to use the generic name by which the patented article has been designated, in the nature of a trade-mark, also expires. The court found, however, that despite this the defendant was chargeable with unfair competition in copying the peculiar design of the trademark of the plaintiff, a certain trade slogan or expression, and in imitating the plaintiff's cartons.

Robb's Patent Essentials.—The Funk & Wagnalls Company have recently published a really excellent rudimentary and practical treatise on patents, by John F. Robb, a well-known patent attorney of the Cleveland and District of Columbia Bars. This work is not only of real value to the patent practitioner, but can be read and used to advantage by anyone interested in patents, directly or indirectly. It is a most useful and instructive book for the inventor and the manufacturer. The volume is of definite service to anyone engaged in patent practice and will prove of high value in assisting to give clear and as nearly as possible non-technical answers to the many questions which business men and inventors encounter.

Doubt as to Patentability Resolved in Favor of Applicant.—The Court of Appeals of the District of Columbia, in a recent decision (in re Glafcke, decided January 23, 1922, No. 1449), reiterated the doctrine that where a distinct advance is made in a given art, and the question of patentability is close, it will be resolved in favor of the applicant, especially where the claims in question are specific in character. The Court said: "There is a twilight zone between invention and mechanical improvement, where it is sometimes difficult to determine in which scale of the balance the applicant belongs, but we have consistently held that in a close case we will resolve the doubt in favor of invention." In support, the Court cited the decision in re Katzenberger, 46 App. D. C., 539.

No Monopoly in Taxicab Color.—The State Courts of New York have recently seen some active litigation involving a particular color combination as applied to the taxicabs of a well-known company operating in New York City and elsewhere, and copied by independent taxicab owners, the particular color combination being black and yellow. The Appellate Division of the Supreme Court of New York recently held that no concern has property rights to the use of any particular color combination for this purpose. In his decision, Justice Page says: "The plaintiff, however, has not demonstrated with sufficient certainty to justify the inclusion in the preliminary injunction its exclusive right to use the color scheme or combination of the colors yellow or orange, and black, arranged in the manner employed by the plaintiff."

Ordinarily Separation of Parts Not Invention.—The Circuit Court of Appeals, Eighth Circuit, recently reiterated the established proposition of patent law that as a general thing it does not constitute invention to make two or more parts out of a thing that had theretofore been used in one part, and using the separate parts to serve the purpose that had been served before the division. (Laclede-Christy Trade Products Co. vs. City of St. Louis, 280 F. 83). In support of this contention Judge Lewis cited Howard vs. Detroit Stove Works, 150 U. S. 164; D'Arcy vs. Staples & Hanford Co., 161 F. 733; General Electric Co. vs. Heat and Motor Co., 205 F. 42. The controlling factor in the holding that there is no invention in such a separation of parts is that no new function or result is brought about thereby, the separated parts merely serving the same purpose as the original, unitary structure.

Deceptive Labels Forbidden.—The public at large, and manufacturers throughout the country, are much interested in a decision of the Supreme Court of the United States, upholding the Federal Trade Commission which had forbidden the Winsted Hosiery Company to employ in connection with its underwear, labels bearing expressions such as "Merino," "Wool" and "Worsted," unless the underwear in question is actually made from those specific materials. The Winsted Company attempted to show that it was customary in the trade to designate such underwear by the terms in question, and that the purchasing public fully understood that the actual composition of the merchandise was different. This contention was not seriously entertained by the court, however, and the decision, it is thought, will have a considerable bearing in causing dealers more accurately and correctly to brand their merchandise.

Commercial Success Not Always Indicative of Invention.—The Courts have repeatedly resolved in favor of a patent a doubtful question of patentability, where it has been shown that the patented invention has met with great public favor and has gone into extensive and general use. However, that this rule is not without exception, was held by the Circuit Courts of Appeals, Third Circuit, in Staso Laminated Slate Co. vs. Stowell Mfg. Co., 280 F. 107. In that case the court held the Schroeder Patent No. 1,007,146, for a prepared roofing, with a protective coating of crushed slate applied by rolling, invalid, because anticipated. As the court properly said, commercial success, though often indicative of invention is not always so, as it may be due to other causes. In the case under discussion the particular roofing is undoubtedly of superior excellence and has been widely used throughout the country during past years.

Design Patents.—In recent years there has been developed on the part of the Patent Office a tendency to grant design patents for articles which are really not ornamental or artistic designs in the sense of the design patent law. The present Commissioner has very properly taken a determined stand against the granting of such patents, which virtually constitute an effort to cover, under the guise of designs, mechanical structures that are really not patentable under the design patent law. The Circuit Court of Appeals of the Eighth Circuit (Metallic Industries, Inc., vs. Brauning, 279 F. 860), has clearly stated what a design must be to be patentable, as follows: "A design, to be patentable under Rev. St., Sec. 4929, as amended by the Act of May 9, 1902 (Comp. St., Sec. 9475), must present to the eye of the ordinary purchaser a different effect from anything that preceded it, and render the article to which it is applied, pleasing, attractive and beautiful, and must involve an effort of the brain as well as the hand." The position taken by the present Commissioner of Patents with respect to having the Patent Office exercise every care in confining design applications to the proper subject matter therefor, has the hearty approval of the majority of patent lawyers, and should likewise be honestly endorsed by the creators at large of inventions of this kind.

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Mechanical Engineering Notes

The Grease Gun. — High-pressure, hand-operated grease guns are familiar to every automobilist, and are, in fact, fast becoming universal factory equipment of the automobile. There is still room, however, for their adoption in ordinary shop practice of a much wider scale than has yet been realized. The machinist and the stationary engineer will benefit as much as the motorist from a state of affairs where it is necessary to go over a series of grease cups only once a week instead of once a day. To pack any bearing with fresh, clean grease in a jiffy, to eliminate the neglect which hard-to-get-at bearings are bound to suffer, to protect against bearing failures, ought to be of interest wherever power or machinery is used.

Ball and Roller Bearings are discussed, with reference to friction and carrying capacity, in Technologic Paper No. 201 of the United States Bureau of Standards. Experiments were undertaken at the suggestion of the Navy Department to determine the maximum safe load, and the static friction under load, of the two types. Tests were made on 1-, 1.25- and 1.5-inch balls in grooved races, and on rollers 1.25-inch in diameter and 5.25 inches long, in both flat and cylindrical races. The ratio of friction to load is practically constant, being equal to 0.00055, for all three sizes of balls up to a critical load which varies with the diameter of the ball. A critical load of 25,000 pounds was found for the rollers, with a friction-to-load ratio of 0.00075.

Wire Cables and Weathering.—Taking advantage of the rewrapping of the cables of the Williamsburg Bridge over the East River at New York City, now in progress, Edward A. Byrne, chief engineer of the Department of Plants and Structures of the city, has been carrying on an examination of the condition of four 18⅜-inch cables of the structure. The sections inspected had the interspaces between wires fairly filled with slushing oil supplied when the cables were constructed (1901-1902) and no signs of corrosion were visible, except for a few spots of discoloration on the outer layer of wires. In the main span rust discoloration on the outer wires was found at a number of places. Still better conditions have been found in the wire-wrapped cables of the Manhattan and Brooklyn Bridges. There the wires, which are galvanized, have in no cases shown any rust.

Air Drill Operating Strains.—When a hundred-odd pounds of air pressure is driven against the pistons of an air drill the crankshaft which shoulders the load must be properly alined and rigidly supported, or every moving part is subjected to abnormal strains. Such support is necessary in permanently securing proper crank-shaft alinement as well, and it can be obtained, in the view of the designer whom we quote, only by placing supports on both sides of the main driving gear. The argument is advanced on behalf of a drill which carries three-point support in place of the more conventional two-point; it is one which might well be taken to heart by every designer of power-driven equipment that is subjected to severe and sudden shocks comparable with those undergone by the air-drill pistons.

Care of Ring-Lubricated Bearings.—A Chicago utility company points out in instructions to its men that regular inspection of the oil rings on generators, converters or motors should be made by the operator to determine if they are turning properly. This is especially necessary when a machine is started up, as the rings are apt to stick at this time. The fact that the oil need be changed only once or twice in a year does not necessarily imply that the bearings are foolproof and need no attention on the part of the operator. If the rings stick and fail to revolve, the bearing will get no oil. This frequently happens, resulting in an overheated bearing and sometimes in enforced shutdown of the machine. Consequently it is an important duty of the operator to make regular inspection of these rings to see that they are turning. If they are not, they should be started with a small hardwood stick which should be kept on hand for this purpose. At the same time, the operator should see that the gage glasses on bearings are at least half full of oil and that there is no leakage around the glasses. In case of any apparent leakage, lack of oil or chronic sticking of any particular oil ring, the matter should be reported to the foreman. When inspecting oil rings on a running rotary, operators should wear goggles to protect their eyes from possible flashovers.

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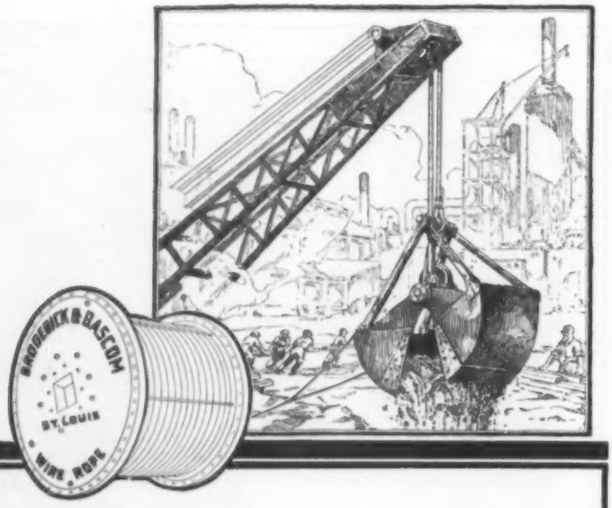

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Chemistry Notes

Pasteur Centenary.—November 22, 1922, will see the centenary of the birth of Pasteur, one of the foremost benefactors of the world. France is already preparing for a fitting celebration of the anniversary.

Silica Brick Industry.—The U. S. Geological Survey reports continued progress for the refractory silica brick industry in 1920. The output was 255,000,000 brick, valued at $15,540,000, or $60.94 a thousand, an increase of 18 per cent in quantity and 32 per cent in value over 1919. Only in the year 1918 was this value exceeded.

Talc and Soapstone.—The United States is by far the largest producer of talc and soapstone, yet our consumption outruns production. According to figures made public by the U. S. Geological Survey, in 1919 we produced 68 per cent of the world's supply and consumed 79 per cent. Talc, widely known in the form of talcum powder, is also extensively used in the industries. This is the pure mineral, and the massive rock containing it is soapstone. In 1920, production exceeded, both in quantity and in value, any previous year; sales were 224,290 short tons, valued at $3,090,265, an increase over 1919 of 21 per cent in quantity and 31 per cent in value. The average price of ground talc was $12 a short ton.

New Mines Laboratory.—The University of Washington, at Seattle, has completed the first unit of its mines laboratory, planned for fuel work and ceramics; this represents five-ninths of the projected construction. The unit, so the *Engineering and Mining Journal* states, will be used jointly by the College of Mines of the University and the Northwest experiment station of the U. S. Bureau of Mines. The equipment is such that carload lots of coal can be handled in coal washing and other tests. All interior construction is steel and concrete, with sloped floors; there are installments of water, gas, steam, electricity, compressed air, electric elevator, and automatic fire doors. The building alone cost $130,000.

Do Our Fertilizers Breed Disease?—Heretofore, to dietitians a vegetable has been a vegetable, no matter what soil nurtured it. Prof. F. M. Keith, of Medford, Mass., has convinced himself that only virgin soil or its equivalent can produce food rich in the necessary elements, and that manures rob, instead of renovating, the soil. Nitrogenous fertilizers produce plants composed chiefly of ammoniacal albumen, and human tissue built from this is abnormally constituted and subject to rapid decay. His remedy is to use only ground rock, and he emphatically states that this innovation has resulted in an increase of 100 to 200 per cent in both the quantity and the quality of his crops. Only this, he says, can prevent us from "eating our way to degeneration."

Artificial Silk.—In answer to inquiries, the Bureau of Chemistry states that it has given no approval to any process for the manufacture of synthetic or artificial silk. An article has been going the rounds, to the effect that chemists of the Department of Agriculture and of the War Department had endorsed a process for the manufacture of synthetic silk on a commercial scale, the result of experiments "developed by America's new chemical industry built up during the war to compete with the German world-wide monopoly of the chemical and dye-stuff industry." The Department of Agriculture certainly aided in perfecting the manufacture of aniline dyes, but knows nothing whatever of the synthetic silk referred to, and certainly has not endorsed it.

Petroleum Production.—The increase in production of petroleum since January, in spite of falling prices, which were checked in June, gave way during July to a reduction of almost 50,000 barrels a day, according to the United States Geological Survey, the daily average production for the month being 1,297,677 barrels. Imports of Mexican petroleum during July, amounting to 8,046,861 barrels, decreased more than 2,000,000 barrels. Consumption of domestic and imported crude oil amounted to a daily average of 1,340,968 barrels, continuing the downward course which, with minor checks, it has followed since November. Stocks, therefore, show a net increase of more than 6,000,000 barrels during the month, and at the end of July pipe-line and tank-farm stocks, plus stocks of Mexican petroleum held in the United States by importers, attained the new high record of more than 167,000,000 barrels, a quantity sufficient to meet consumption at the current rate for 124.7 days.

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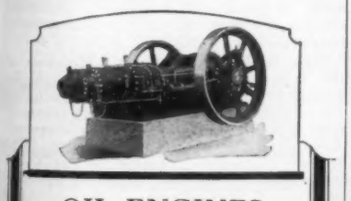

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The Naturalist's Corner

Poisonous Olives.—Dr. Rosenberger of Jefferson College states that the presence of *Bacillus botulinus*, the poison of olives, is readily detected by the strong smell and cloudy liquor. Good olives have a pleasantly aromatic odor.

Americans as Lotus Eaters.—From the Iowa Conservation Board comes the suggestion that we grow water-lilies as a staple article of food. It is claimed that the lily when peeled and boiled is as farinaceous and tasteful as the potato.

Grapes and Temperature.—In a report of the American Chemical Society it is shown that weather conditions are an important factor in determining the sugar content of grapes. Warm days and cool nights tend to produce the maximum amount of sugar.

Hawaii Imports a Bug.—An Australian bug of the high-sounding name of Ischiogonus is being imported by Hawaiian sugar planters to battle with Syagrius Fulvitarsis, a scale-armored insect which destroys the mountainside ferns that preserve the watersheds so necessary to the irrigation of the plantations.

A New Forest Station.—The southern Appalachian area on which we have long depended for our hardwood has fallen off 60 per cent in production; three-fifths of the original stand is gone. An experiment station is to be established at Asheville, N. C., to study the best methods of combating this depletion.

Oil Nuts in Guatemala—Guatemala abounds in oil-bearing nuts that only await proper handling to become the basis of a great industry. Their oil content is said to be 65 per cent, as compared with 42 per cent for African nuts. On the north coast 60,000 tons of cohune nuts are annually available for export, but improved roads are badly needed.

Tobacco Disease Runs Wild.—"Wildfire" is the name of a tobacco disease with which State experts are experimenting at Windsor, Connecticut. Lately it justified its name by getting away from them and overrunning an adjoining field. A few infected plants placed in a basket with healthy ones will infect the whole basketful in a few hours. Last year this disease did enormous damage.

Wherein the Deadly Germ Is Not at Fault.—It has been found that the black discoloration in canned sweet potatoes is due to the iron dissolved from the can, combining with the tannin-like substances in the potatoes. Although the access of air is necessary for this to take place, thereby emphasizing the need of tight seams, the danger from this factor is apparently greater than from the invasion of bacteria.

Southern Tree Conservation. — So marked has been the destruction of the timber lands in the Southern Appalachian region that the Department of Agriculture has established a new forest experiment station at Asheville, N. C., to determine methods of conservation and control. This station is the first of its kind in the Eastern States. A further object of the establishment is to secure information for foresters regarding the handling of southern trees.

Scientific Methods in Plant Introduction.—Some eighty-odd years ago the French Government made a costly attempt to introduce the culture of the tea plant, importing for the purpose three thousand shrubs. Notwithstanding the care taken in the selection of soils and areas to plant them, the enterprise resulted in complete failure. It is, of course, now known that this plant will not thrive without an average temperature of 61 degrees Fahrenheit, together with considerable atmospheric moisture. The English Government, however, in the same sort of undertaking was not so easily misled. After a calculation of various heights suitable for temperature and humidity, it fixed upon the slopes of the Himalayas. Today tea ranks among the chief sources of wealth of British India. Thus the importance of studying the natural conditions of growth among exotic plants is evidenced. We therefore await with interest the result of researches being conducted by the Mulford Biological Exploration of the Amazon. There has already been received in this country a shipment from this expedition. It includes, besides botanical specimens of economic products of Bolivia and Peru, a quantity of medicinal herbs the properties of which may prove to be of untold value.

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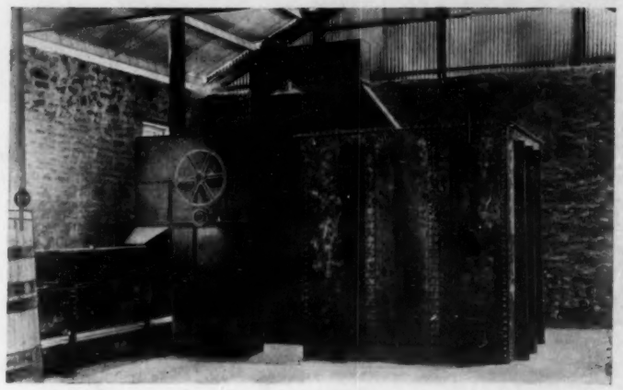

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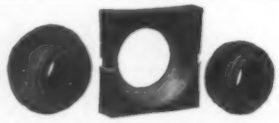

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Radio Station on Rundemanden.—The radio station on the Rundemanden, a mountain towering 2,500 feet above the city of Bergen, Norway, is being modernized and equipped with more power apparatus as well as with radio telephone apparatus. As the new equipment has a radius of 3,000 kilometers, it is believed that direct communication with American radio stations will be possible. Radio telephones with a 600-mile radius are also to be installed and connections with England and continental Europe established.

Radio Traffic on the Increase.—A new record has been attained by the radio service of the Drahtlose Uebersee-Verkehr, A.G. (Overseas Wireless Company) of Germany. On March 16, last, a total of 50,000 words were exchanged via radio at the radio stations of this company at Nauen and Eilvese. Since the reconstruction of commercial relations the traffic through these radio stations has been steadily increasing. In August, 1919, the entire business for the month only amounted to about 100,000 words. It increased to 550,000 words in June 1921, and in February, 1922, rose to 1,000,000 words.

Radio-Frequency Amplifier Sets.—Despite the fact that radio-frequency amplifying apparatus is tricky and difficult to build and handle, there have now appeared on the market a number of radio-frequency units which may be used in connection with the usual receiving set, as well as complete receiving sets with one-, two- and even three-stage radio-frequency amplifiers, a detector, and one or two stages of audio-frequency amplification. It is still too soon to say just how efficient these manufactured radio-frequency amplifiers are, but we hope that they are thoroughly practical and devoid of all the experimentation that generally goes along with a home-made radio-frequency outfit.

Martian Radio Signals.—Again the radio perennial—Martian signals—is with us at least as this is being written. The reception of mysterious radio signals of great wave length from some unknown source is reported at regular intervals of about fifteen months. As a play to the imagination, nothing is more fascinating than the reception of these mysterious signals which are held, by some, to originate somewhere off in space, but nothing regarding these signals has ever been determined by true scientific methods. That they are received, there can be no doubt; but that these signals originate from some neighboring planet, seems unlikely in the extreme. Most likely they are disturbances due to some natural or artificial cause right here on this little globe of ours.

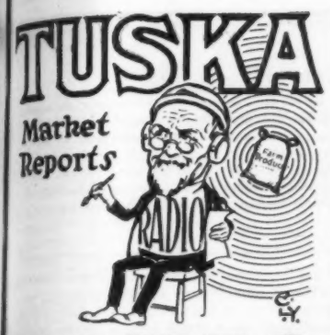
Radio Telephony in South Africa.—The possibility of utilizing radio telephony in remote and difficult parts of South Africa has been engaging the attention of the Post Office authorities. Two suitable Marconi sets were purchased in England and various trials and tests were made by the local representative of the Marconi Company in Swaziland and other remote regions, as well as between Cape Town and Touws River in the Cape Province, a distance of 160 miles. While these trials proved very satisfactory so far as the range and efficiency of operation under favorable atmospheric conditions were concerned, the Post Office authorities express some doubt as to the commercial practicability of the method, particularly in a sparsely settled country like South Africa where the amount of traffic between the outlying districts would not be sufficient to guarantee the cost of the installations.

Municipal Radio Stations.—Considerable talk is being indulged in by municipalities in various parts of the country looking toward the establishment of radio transmitting stations, according to *Electrical World*. A number of cities are already using the radiophone for police purposes in a limited way and some use is also being made for broadcasting purposes. Chicago has had a well-equipped station in operation since last fall experimenting with the police and fire department uses and is believed to be the first American city to maintain a regular broadcasting schedule. Such a schedule has been maintained for several months and consists of talks on matters of public interest from authorities on the subjects selected, as well as musical and other entertainment features. New York has announced that it will erect its own station. Dallas has been using radio in its police department, and in a number of cases broadcasting stations owned by private parties are cooperating with police authorities in the broadcasting of police and other news.

Radio for the Paris Police.—The radio telephone has been introduced in the operations of the Paris police force with promising results. Regular radio telephone communication is now maintained between one police airplane, two police automobile ambulances, and headquarters, all four being equipped for sending as well as receiving, according to *Radioelectricite*. Standard French military sets are used, supplied with current from a propeller driven generator on the airplane, and from storage battery-driven motor-generators in the ambulances. Two four-meter long steel tubes, attached at the end of a bakelite stick, form a mast to support a 40-meter single-wire antenna, the other end of which is fastened to a short bamboo pole, driven in the ground. If no gas or water outlets are available for a ground connection, a copper wire mesh 10 meters by 0.8 meters is stretched out on the ground. Only ten minutes are required from the instant of arrival to make the necessary set-up. Perfect telephonic conversation can be maintained among these stations within a radius of about 30 kilometers.

The International Union of Scientific Radio Telegraphy was organized two years ago for the purpose of furthering, through international cooperation, the systematic study of the fundamental problems of radio communication. Separate sections have been found for a number of different countries, and the work of the American section has been in progress for over a year. Recently systematic measurements have been made at receiving stations in the United States of the intensity of signals received from various French stations, and by a continuance of these measurements it is expected that more comprehensive knowledge will be obtained of the phenomena of radio transmission. A meeting of the American section was held very recently, at which various committees reported, including the committee on the study of radio wave intensity, atmospheric disturbances, variations of radio wave direction, measurements of radiations which cause interference, and electron tubes. Particularly in the case of measurements of the intensity of radio waves, it is important that international cooperation be promoted, since it is only by frequent simultaneous measurements made cooperatively by widely separated sending and receiving stations that accurate results may be obtained.

New Radio Publications.—Members of the staff of the radio laboratory of the Bureau of Standards have recently published three papers describing certain apparatus used in investigations in the radio laboratory. A paper by R. T. Cox, entitled "Standard Radio Wavemeter, Bureau of Standards Type R60B," describes a standard wavemeter constructed at the Bureau of Standards and used in the standardization of radio apparatus. A paper by H. A. Snow, entitled "An Electron Tube Amplifier for Amplifying Direct Current," describes an amplifier of the type indicated by the title which has been developed at the bureau for particular applications in electric signaling work. This amplifier can be used in place of a polarized relay and also for various other purposes, including the recording of telegraphic radio signals. A paper by E. L. Hall and J. L. Preston, entitled "High-Voltage Storage Battery for Use with Electron Tube Generators of Radio-Frequency Currents," describes a special type of storage battery developed at the bureau employing a considerable number of small storage cells contained in small glass jars about 1½ inches square and about 4 inches high. These cells are assembled very compactly in trays which can supply 100 volts, and storage batteries of this kind for supplying small currents required for some kinds of electron tube sets may be conveniently assembled to occupy a very small space.



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Government Activities

Apple Pests in Pictures.—"King Apple's Enemies" is a motion picture lately released by the Department of Agriculture. It shows the mobilization of insects and fungi against the apple kingdom, and shows the spraying and dusting "guns" moving into action, and the repulse of the foe. The film is one of 150 that are being used throughout the country by agricultural extension and field workers.

Squirtless Grapefruit.—The Department of Agriculture is turning its attention to the tangelo, a cross between the orange, tangerine and grapefruit that in appearance resembles a round orange. There are two varieties, the Sampson and the Thornton; the latter is less acid than the former, but both are delicious in flavor, while the Thornton exhibits little tendency to squirt when the spoon is inserted in the segment.

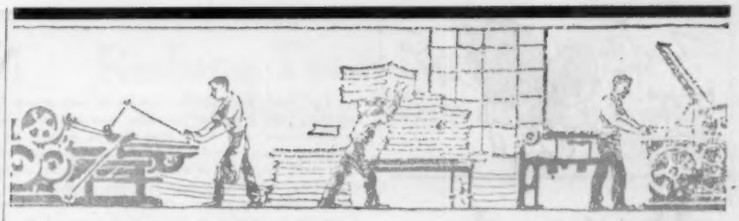
Adulterated Coffee.—Food inspectors have found that certain coffee grinders and sellers are adding to the lower grades of coffee chaff and screenings to as high as 25 per cent, so the Bureau of Chemistry reports. Their specialists hold that chaff and screenings are not coffee, and that such mixtures are adulterated and misbranded under the provisions of the Food and Drugs Act when labeled, sold, or offered for sale as coffee. Action will be taken against all such violaters of the law.

Dairying Taught by Tableaux.—A feature of the National Dairy Show was realistic stage settings contrasting Farmer Slack's place and its nondescript cattle with the model farm, next door, which breathed comfort and prosperity. Another setting showed how the farmers of a community grouped their farms into blocks and organized a bull association that resulted in a marvellous development in the herds, corroborated by records posted at the side of the stage. And these were but a small part of the story of milk production and marketing unfolded by the artist's brush and by actual demonstrations.

The Story of Chaulmoogra.—Buddhist histories relate how, a thousand years ago, a Burmese king was cured of leprosy by chaulmoogra oil extracted from the seeds of the tree, *Taraktogenos Kurzii*. In 1856, British scientists thought they had found the elusive tree; not until 1899 was it discovered that they had distributed seeds of an entirely different kind. More recently, 200 Hawaiian lepers were apparently cured by chaulmoogra oil. Prof. J. F. Rock, of the Department of Agriculture, has now penetrated to the remote sources of supply in Burma, and has sent back the genuine seeds. The Hawaiian government has set apart 100 acres for a plantation of the trees, where, under American jurisdiction, they are expected to come into bearing within eight years after the planting of the seed.

"Production's Pulse."—This is the name of a new film issued by the Department of Agriculture, which picturizes the crop-reporting service of the Bureau of Markets and Crop Estimates. The story opens with a farmer who is uncertain whether to sell his corn, hold it, or feed it to his stock. It passes on to the 42 State field agents literally "spying out the land;" behind these is an army of 215,000 voluntary crop reporters. To prevent leakage of information, all reports are put in a locked box in the office of the Secretary of Agriculture; when computations are made on these, the tops of the sheets are cut off so that computers do not know on what State they are working. The film ends with Farmer Harrow getting his newspaper carrying the official report, which helps him to answer his questions.

Our New Horological Institute.—There is a serious scarcity of watchmakers in the United States; the science of horology has been neglected, and we lack standards by which to judge efficient workmanship. To remedy these conditions, George W. Spear of Washington planned a new organization and persuaded the National Research Council to support the plan; the Institute is now fully organized and is functioning. It is to establish and develop a system of high-grade horological schools, to provide for the voluntary certification of watchmakers in three grades, and to unite into one national body all those interested in the science of timekeeping and the advancement of watchmaking in America. The American National Retail Jewelers Association has passed a resolution applauding the Institute and its objects, recognizing in its founding the beginning of a new era, and pledging to it full moral and financial support.



To the Man Whom We Call "Casual"

To the man who reads the pages of "Scientific American" occasionally at the club or in his office—but whose name we do not have on the permanent subscription—we address this personal invitation.

Many, many letters that seek the help of a "Scientific American" editor in some particular mechanical or industrial problem, contain the general suffix "I have been reading your magazine for more than 30 (40 or 50) years." Here is indeed a publishing goal hard to attain—and we work continually to this end today and every day. Converting casual readers to 30-year subscribers is the ambition of this advertisement.

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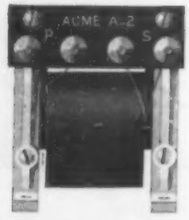
Putting the "howler" to sleep

THERE'S more than one "howler" to put to sleep these days. Your radio set can put on the greatest squalling and howling demonstration you ever dreamed of. The surest way to stop this howling and keep it peaceful is to add an Acme *Audio* Frequency Amplifying Transformer.

Most any amplifying transformer can magnify the incoming sounds but it also amplifies the howling and distortion of stray fields in the circuit. Acme Transformers with their specially constructed iron cores and coils eliminate this disagreeable feature—and it only takes five dollars to buy one.

Acme assures your receiving a large volume of sound that possesses the natural tones so lacking in the ordinary receiving set. Then, too, you will want the Acme *Radio* Frequency Transformer, which costs the same as the Acme *Audio* Frequency Transformer. It can be used on both crystal detector and vacuum tube sets. It greatly increases the range of either.

You can buy either transformer at your nearest radio store or write the Acme Apparatus Company (pioneer transformer and radio engineers and manufacturers), Cambridge, Massachusetts, U. S. A. (New York Sales Office, 1270 Broadway). Ask also for interesting and instructive booklet on the use and operation of Amplifying transformers.



Type A-2 Acme Amplifying Transformer, Price $5 (East of Rocky Mts.)

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Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or researches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscriptions, books, etc. This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a few of them can be printed in the limited space at our disposal.

(14406) J. C. W. asks: Scientists, basing their estimates by means of abstruse mathematical calculations upon the Newton theory of gravitation, just how much a body will weigh if it could descend toward the center of the earth and also the effect upon it in its ascent from it. The object of this writing is to inquire whether any attempt has been made since aviation has reached such a stage of perfection, that a height of over 25,000 feet has been attained, to test the truth of those estimates by actually weighing a body, by means of a spring balance, at some great height. The only way to prove a theory is by facts. I shall greatly appreciate a reply. A. The experimental method of proving the law of gravitation which you suggest would be very difficult of application from an airplane. The mean radius of the earth is 3959 miles. An airplane at six miles above the earth's surface is 3965 miles from the center. The change of weight at this height is $\left(\frac{3965}{3959}\right)^2$. This is about .003 increase and too small to be detected by weighing on a moving and unsteady platform such as is an airplane. Weighing upon a high mountain would be much simpler, but nothing would be gained by this, since the motion of the moon around the earth is a better proof of gravitation than any experiment could be. There would be the same difficulty in weighing at the bottom of a deep mine shaft, the deepest of which is about one mile deep. Weight at the bottom of such a shaft would be $\left(\frac{3958}{3959}\right)^2$ or about .0005 less than weight at the surface and this is too little to discover with certainty by any balance. The fact that the planets keep their predicted places after years have elapsed is the best proof of the truth of Newton's work.

(14407) C. B. H. asks: Kindly give me a brief outline of the process of making arc light carbons. Also, is there any special method by which the resistance of the carbon may be increased? Please tell me where I can get information about artificial diamonds. A. Arc light carbons are made from pulverized graphite. This is mixed with some carbonaceous liquid such, perhaps, as cheap molasses or coal tar, to the consistency as desired. The mass is rammed into molds with hydraulic pressure and the rod is baked without access of oxygen in a furnace till hard. The resistance can be increased by mixing pulverized substances which are non-conductors with the graphite. This would not be desirable for ordinary use.

(14408) A. S. E. asks: According to the accepted theory thunder is caused by air, parted and expanded by the flash of lightning, coming together again violently. Laboratory experiments in the analysis of water make me think that perhaps thunder may be, instead, the result of the electrolysis of the moisture in the air into hydrogen and oxygen and the reconversion, by lightning, of the mixed hydrogen and air back to water. This would not only account for the explosive crash heard but for the heavy showers that follow a thunderstorm. Would like an expert's opinion on the matter. A. A flash of lightning does not seem to us to be different from the discharge of a Leyden jar or other condenser except in size. In the discharge of a condenser there is no electrolysis of water or recomposition of oxygen and hydrogen into water again. In a shower some water may be decomposed. If there is it is the result of the passage of the electric current which constitutes the lightning, and which precedes the thunder, and not follows it as you seem to imply in your letter. A stress is set up between two unlike charges and when the intervening air can no longer withstand the strain the air breaks down and a flow of electricity occurs, burning material as it goes, heating the air, causing some of its nitrogen and oxygen to combine and some of its oxygen to be changed into ozone. All this causes a violent expansion of the air which falls back into the partial vacuum and this collapse causes a loud sound, the thunder. It is very much like the water-hammer in a steam pipe only on a very much greater scale. This seems to us very simple and reasonable and not to require any addition to the theory.

(14409) E. B. asks: Can you give me any information upon the return of the old theory of alchemy? Have read in different places that the science department of the Harvard University has recently become interested in this old theory. A. The ancient alchemist sought the philosopher's stone which was to turn anything into gold by a touch. The modern chemist has no such idea. He is working his way into nature's secrets of radioactivity, which are now quite mysterious. He finds that certain emanations, as he is forced to call them for want of definite knowledge, are coming off from certain substances and that then properties like those possessed by certain other well-known substances have appeared. Thus radium gave off helium, and some think lead is at the end of that chain. The latest work in the physics of the atom and the electron is reminiscent of the alchemists, in that it appears that we are actually going to be able to transmute elements in some cases at least; but the parallel is not at all close, and any effort to make it so does injustice to modern science while elevating alchemy far above its true place. The alchemists had no clear idea of what they were trying to do; what they said and thought was so indefinite that it meant nothing, and hence may be tortured into meaning anything that will put it in accord with present developments.

(14410) G. S. asks: How can the moon revolve around the earth, and earth and moon revolve around the sun under the action of centrifugal and centripetal forces with varying velocities and at varying distances from their centers of motion and still maintain their orbits undisturbed from age to age? A. The problem which is troubling you is a very real one and a very difficult one. It is called the Problem of Three Bodies. A simple presentation of the case is to be found in Moulton's Introduction to Astronomy, the chapter on the Motions of the Earth. Prof. Moulton is our foremost authority upon Celestial Mechanics to which the problem belongs. A fuller statement may be found in the Ency. Brit. 11th Ed., Vol. 2, page 804c. This you may consult at the Public Library. It is to be emphasized that the earth and moon are not like a ball fastened to a string. The ball moves in a circular arc, and the moon in an ellipse. The centrifugal and centripetal forces are not in equilibrium except at two points in the orbit in a year. The centrifugal force is greater than centripetal in the winter season, when perihelion occurs and less than centripetal in summer when aphelion occurs. The discussion in the text books of Celestial Mechanics is wholly mathematical and very complicated. The explanation in Moulton referred to above is as simple as it can be made. The earth and moon are both affected by the sun and their motions are greatly modified by that body, hence the name the Problem of Three Bodies.

(14411) L. A. W. asks: How does the heat from the sun escape from the earth, and where does it go? A. Your question "How does the heat which we receive from the sun escape from the earth, and where does it go?" may be answered in a few words. It is radiated into space just as the heat of a hot ball on the earth is radiated. The reason the upper reaches of the air are colder than the air at the surface of the earth is that the air is less dense and less able to retain the heat which the sun has given it. You cite the thermos bottle as preventing the escape of heat. It only retards the escape of heat. In time the hot contents become cold. So, too, an electric light bulb allows much heat to pass out through the vacuum it contains, a much better vacuum than there is in most thermos bottles. This brings us to the point, there are degrees of heat. Heat of high degree, that is, of short wave length, passes readily through the highest vacuum, such as is found in an incandescent lamp bulb or an X-ray tube. That of low degree, of long waves, passes with difficulty through a vacuum. This heat the denser air is able largely to retain, and thus the earth is kept warm at the level of the sea. Thin air can not so completely retain heat, and on the tops of mountains are very cold. The air as it is cuts off about 40 per cent of the heat of the sun which strikes it and about 60 per cent reaches the earth's surface to warm it. All this escapes again into space, since the earth year by year does not become any hotter, as it would if it retained more heat than it radiates. It is true that the energy sent us by the sun is not heat till it strikes something which can convert it into heat, nor is it light till it hits some organ which can transmit it into light. The only light there is is in the eyes of living beings. That which comes from the sun is simply energy. Maxwell long ago gave us the theory that light is simply an electromagnetic effect. These matters have long occupied the attention of scientists, and the statements we have made above are usually accepted as conclusive by them. You will find a simple presentation of Maxwell's theory in Ganot's Physics.

(14412) W. W. asks: Would you kindly tell me what the vibrations from the lowest number per second progressively to the highest number per second are known as. I think that, quoting from memory, sound is from about 40 to 4500 per second and the colors from red to violet have their rate of vibration. Heat and the X-ray also have their place in the scale. A. Sound is often expressed by the number of vibrations per second which produce it. The lowest note which affects the ordinary ear has 16 vibrations and the highest has from 32,000 to 40,000 vibrations per second. Ears differ in range. The lowest tone in music has about 19 vibrations. The wave length of a tone is found by dividing the velocity of sound by the number of vibrations. Other vibrations are always expressed in wave lengths and not in number of vibrations per second. In light the lowest red visible to the eye has a wave length of about 300 ten millionths of an inch (.0000300) and the highest violet visible has a wave length of about 150 ten millions of an inch (.0000150). You can find the number of vibrations by dividing the velocity of light by these numbers. The heat spectrum has been detected some ten times the length of the visible spectrum below the red, and the ultra-violet spectrum has been traced about the same distance above the violet of the visible spectrum. Each unit of length below the red would double the wave length of the waves, and above the violet would halve the wave length. X-rays are now known to have wave lengths still shorter than these.

(14413) A. D. C. asks: I would be very grateful indeed if you could tell me of what the powder which one can buy to put upon a wood fire to make it give a driftwood flame is composed. I have often wondered if it was not some chemical compound which one could get at a chemical supply store much cheaper than at the department stores at Christmas time. A. You can buy the chemicals for making a colored flame, such as is called "driftwood" fire, from dealers in chemicals. They are: for green fire, copper chloride; for red fire, lithium chloride or strontium chloride; for yellow fire, sodium chloride, which is common table salt. Dissolve these in a wooden pail with water, soak the sticks of soft pine wood in the liquid until saturated with it, and then dry them. They will then burn with beautiful colored flames. Their preparation is very easy and the pleasures to be derived very great.

Miscellaneous Notes

Odd and Interesting Items from All Sorts of Sources

Fox Farming in Prince Edward Island last year produced a revenue of $1,240,000, nearly as much as the Island's fish and dairy products combined. Three thousand pairs of breeding foxes resulted in an increase in young of 7,500.

Hemp-Stripping in Davao Gulf.—The crude hemp-stripping machines of Mindanao pull the hemp over a knife, imitating hand practice; yet by their aid a man can strip 140 pounds of fiber a day; by hand this would take him a week.

A Process for Joining Mica has been patented by a Calcutta man; it consists in bringing the parts into contact, applying a mica solvent, and subjecting the whole to heat and slight pressure. With borax used as a flux, mica may thus be joined to metal.

Platinum Thieves at Work.—Poised above the crowded streets of Paris, on the Tour St. Jacques, thieves sawed off a lightning rod containing 15,000 francs' worth of platinum. The falling rod stopped the hands of the clock and established the hour of the theft as 7:09. A few months before, the gang had successfully robbed Notre Dame of 25,000 francs' worth of the metal.

A School for Postmasters.—The newly-appointed postmaster now has to submit to a week's schooling at the Central Accounting Post Office in each State. Here it is made plain to him that he is a local manager for the biggest business institution in the world; he is taught how to educate the public in the use of the mails, the handling of complaints, and the economy detail of his service.

Rivet Cutting Record.—In tearing down a standard freight car under ordinary yard conditions, an operator recently cut out 1008 rivets in two hours and forty-six minutes. Heavy scale and rust made the cutting difficult, and it was necessary to work inside, outside, and under the car. At the same time a record was broken for low consumption of gas; only 384 cubic feet of oxygen and 83 feet of acetylene were used.

Circling the Globe in a Sailboat.—Four Austrian sportsmen plan to sail around the earth in a boat of 12 tons displacement, 46 feet long. The vessel will be provided with a small six-horsepower motor for use in emergency. Two Americans have already accomplished this feat—Captain Slokum, in a voyage lasting from 1895 to 1898, and Captain Flemingday, from 1912 to 1914. In a third attempt, by two British officers in 1913, the men lost their lives between New York and England.

The Shrimp Industry in Alaska, at present centered at Petersberg and Wrangell, seems capable of marked extension. A small collection from a recent catch with a beam trawl in Thomas Bay was found by the Bureau of Fisheries to contain 8 species; some of the specimens of *Pandalus platyceros* measured 9 inches from tip of rostrum to end of tail. Freshly cooked shrimp in the shell may be bought by the pound in paper bags at Petersburg, as is the custom also in England, and are eaten as we eat peanuts and popcorn.

Insuring Against Lack of Snow.—A unique insurance policy was that drawn in favor of a motion picture organization engaged in producing "The Two Orphans." This film calls for a veritable snowstorm, and the policy provided that in the event of such a storm not occurring before November 20th $25,000 would be paid the producing company. Contracts with leading actors expired on that date, and no snow would mean reengagement at prohibitive expense, or "shooting" all scenes over again with a new cast.

Print Bill Cut Two Million.—The Government Printing Office, the largest printing establishment in the world, used 50,000,000 pounds of paper during the fiscal year ending June 30, 1921. The sheets, laid flat, would cover 35 square miles; piled in the form of octavo books, they would extend 500 miles into the heavens. Total expenditures were $11,111,111, compared with $13,000,000 for the previous year. The office prints, besides the speeches of legislators, numerous Government publications, Congressional documents, and stationery.

Rubber in Paper-Making.—The depression in the rubber market is being offset by new uses for the crude material. One such use is indicated in a recent patent that reduces the cost of paper-making, simplifies the methods, and gives an improved product. The folding number of an ordinary fiber was 30; with one-tenth of 1 per cent of rubber added to this fiber, the product had a folding number of 5000 to 6000 and a tensile strength of two or three times the untreated fiber, while a rubber content of three-fourths of 1 per cent raised the folding number to 14,500.

The Museum of Scotland Yard has been reopened—but not to the public; only police officers and others professionally interested may view the gruesome relics. Plaster casts of murderers' heads line the encircling shelves, and the souvenirs of sensational murders include poisons, arsenical paper used in the Maybrick affair, locks of hair from the head of Dr. Crippen's wife, and the pestle with which a woman was killed in a railway carriage. Masks, revolvers and knives abound, and there is a "put and take" top with which the spinner did all the taking and none of the putting.

The Crusaders as Distillers.—Prohibitionists like to regard themselves as crusaders in a good cause; their fight is largely directed against the "still"—so called, perhaps, because it lies quietly hidden and is hard to find. But few prohibitionists are aware of the shocking fact that the vogue of the still in Europe was due to the original Crusaders, who took kindly to this Eastern recreation and brought back with them recipes and methods that made the still as popular an institution as the royal jester—and doubtless helped along democracy by making it hard at times to distinguish the king from the clown.

Treasure-Hunting From an Easy Chair.—Otto Kiep, librarian of Ottendorf, found among his family archives many references to a treasure supposed to have been buried by Stortebecker, a notorious pirate. Herr Kiep examined the records of several medieval castles and, by deductive reasoning, pitched upon one near Neustadt. Choosing a likely spot on this site, he secretly dug there, and actually found a chest of gold pieces. He reinterred the chest, and is seeking the promise of the owner of the estate that shall receive the legal tariff in return for his disclosure of the hiding-place. He now believes that this treasure was cached by another pirate, and is bending new efforts toward finding the Stortebecker hoard.

What Is "Sheffield Plate"?—The process of welding silver plates on both sides of a copper sheet took the name of "Sheffield Plate" from the English town. Electroplating superseded this practice, and today the term is used recklessly in the trade, for products of superior and inferior quality alike, because it conveys a suggestion of "quality" to the buyer. Fifty per cent of the manufacturers, in conference with the Federal Trade Commission, have condemned this practice, defined the word as meaning "an article well-plated on a base metal of nickel silver of not less than 10 per cent nickel content," and agreed to abide by this definition in their own business. The Federal Trade Commission is inclined to disapprove of the use of the word as a trade name or mark for silver-plated hollow-ware, irrespective of definition.

Fifty World's Fairs in 1922.—The old-style "world's fair" was an extravagant, flimsy fairyland that housed, for the most part, objects of art and educational exhibits, and disappeared as if wrecked by an earthquake. More than 50 world's fairs are scheduled for Europe this year, but their main object will be the extension of commerce rather than the proud exhibition of local and national treasures. Europe now regards such expositions as valuable agents for promoting trade; in this attitude it returns in principle to the fairs of the middle ages. The Sample Fair held at Prague last year, though but a minor example, brought together 2500 exhibitors. Exhibition trains are supplementing the advertising value of the fairs; witness the completely-equipped train brought from France last fall, that made an extensive tour of Canada.

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TUBES howl and whistle because the layers of which condensers are composed dilate and contract.

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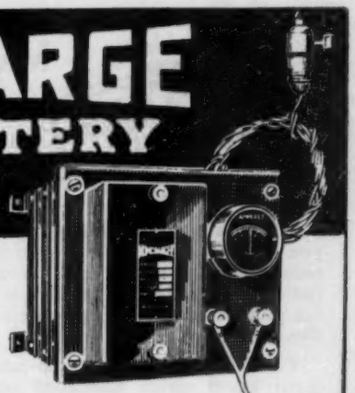

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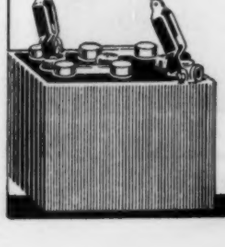

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Aeronautical Notes

Spraying by Airplane.—Worms having twice defoliated a grove of 5000 catalpa trees near Troy, Ohio, an aviator, flying within 25 feet of the tree tops, released an insecticide in powder form that was carried by air currents into every part of the grove.

Germany's Total War Planes.—The number of planes built in Germany for war purposes and destroyed under the conditions of the Peace Treaty is simply stupendous. From Berlin the figures given for aircraft destroyed and surrendered up to October 1st of last year are 127,471 airplanes and 20,364 airplane engines destroyed and 629 airplanes and 3,632 engines surrendered.

Subsidies for Aviation.—France and Belgium grant varying sums toward payment of pilots, cost of gas and oil, etc. Germany gives a premium on the number of kilometers flown. England pays a subsidy which, for 1922, is placed at £200,000, which subsidy, it is stated, is for services from London to Paris, to Brussels, and also to Amsterdam, the British competing with a Dutch company for the service between Amsterdam and London.

A Swedish Aero Show.—Reports from Sweden indicate that it is intended to hold an Aero Show in Goteborg, Sweden, in 1923. The time tentatively fixed for the exhibition is July 7-13. It is stated that the Society of British Aircraft Constructors and the Chambre Syndicale des Industries (Aeronautiques (France) have been approached on the subject of participation in the exhibition and have given favorable replies. It is also hoped that Italy, Germany, Czecho-Slovakia and the United States will participate.

X-Ray Inspection of Aircraft Material.—Dr. V. E. Pullin, Director of Radiological Research at the Royal Arsenal, Woolwich, lectured recently before the Royal Aeronautical Society on X-ray inspection. With the type of equipment now developed by his Department, Dr. Pullin showed that it was possible to detect interior flaws in steel or other dense metals up to three inches in thickness, to recognize porosity in aluminum castings, to discern worm holes in wood, and many other faults not otherwise discoverable except by a process of dissection, and he suggested that the method might be of very great value for aircraft inspection.

Mushroom-Picking by Airplane is one of the latest aeronautical novelties. From the London *Evening News* we learn that A. S. Keep, chief pilot of the Westland Aircraft Company, likes mushrooms so much that when all the known places were found to be barren he decided to go aloft and "observe." He had almost "worn himself to a shadow" walking around the country. Mr. Keep started off in his machine and, flying at a height of 50 feet, suddenly saw a field with small white dots. He promptly landed and found himself in a veritable nursery of mushrooms. In a short time he had collected about eight pounds, which he put in the cabin of the plane and flew home rejoicing.

Radio-phone from Baloon.—An interesting radio-phone test between a spherical balloon and the ground was recently conducted at McCook Field. The object of the flight was principally for the purpose of testing out the radio telephone apparatus in connection with experiments being conducted at the field. Lieut. Schneeberger states that at a height of 3000 feet the best speed was gained, the balloon being carried along by the wind at a rate of 45 miles per hour. The radio tests were in every way satisfactory and provide that rapid improvement is being gained in this means of communication. Conversation was carried on both to and from the balloon and the field until a distance of 40 miles was reached, while indistinct communication was held from a distance of one hundred miles.

Measuring the Height of Clouds.—Among the many important developments being tested in France for the proposed scientific illumination for night flying airmen on the London-Paris route is a method of finding the height of clouds. The apparatus consists of a powerful searchlight for throwing vertical beams on clouds and an especially designed theodolite, through which to observe the clouds. The searchlight is placed at the measured distance from the theodolite, which consists of a telescope mounted in such a way that the angle at which it is pointed can be read with minute accuracy on a special scale. It is set so that the point where the beam enters a cloud can be seen through the center of the telescope of the theodolite, with

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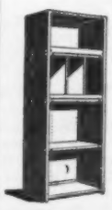

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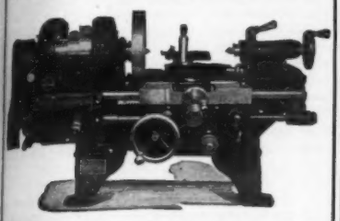

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the result that it is easy to calculate the height of the cloud from a known angle. It is proposed to establish this apparatus at stations along the airway so as to inform pilots of cloud distances by radio.

Aerial Beacon on Staten Island.—Some time ago the Sperry organization installed a high-tensity vertical beacon at Tompkinsville, Staten Island, about 100 feet in from the shore and about 1000 feet eastwardly from the great Municipal Ferry Docks connecting with South Ferry, Manhattan. The light will be vertical over this spot, gradually waving between 10 and 15 degrees each side of the vertical, making four beats a minute. The Lighthouse Commission is issuing a circular requesting observation on this beacon. Pilots of the U. S. Air Service are requested to make observation at the first opportunity and report to the Chief of Air Service as to the observation possible under the various weather conditions existing over Staten Island.

Reliability of Aero Engines.—The London *Financial News*, commenting upon the astounding mileage achieved by airplanes making daily flights between London and Paris, states that the most successful machines operating between these two cities have been the DH-18's, which, fitted with a single 450-horsepower Napier aero engine, have a passenger-carrying capacity of eight and a total loading capacity of 18,000 pounds. These Napier engines run the remarkable distance of 10,000 miles before they are taken down for examination, not because it is necessary, but merely as a precautionary measure, just as a careful car owner will have his engine taken down after a similar mileage. After examination these engines are reassembled and put into service again. Some of the Napier engines on the London-to-Paris aero mail have actually covered a distance of 25,000 miles and are still making the daily journey.

Anti-Aircraft Service of the Future.—Its future development will be in proportion to the development of the Air Service, and will be of vital importance. What will it be used against? It was almost impossible for it to reach aircraft of the 1918 epoch, and it will be still more difficult for it to reach that of the future, whether the latter fly close to the ground at high speed, or high out of range. The problem confronting the Anti-Aircraft Service is a complex one, because it consists not only of perfecting its present equipment, which will soon be obsolete, but of finding weapons which will render it more efficacious in the future. The field is a wide one for investigators and inventors; and we will leave the problem to them, confining ourselves at the present time to the question of perfecting present equipment. The machine-gun bullet will be ineffective against the low-flying plane of the future, because the latter will be completely armored. It will be replaced by a more powerful type of gun, or a quick-firing cannon of small caliber having a high rate of fire and a great muzzle velocity, throwing a shell which will explode on contact. The time when cannon will be powerless against aircraft may be looked forward to, but certainly not in the near future.

Speedy Monoplanes.—The Nieuport monoplane was a plane to conjure with in the early days, and its reputation for speed has outlived that of many of its pioneer rivals. The latest model—Nieuport-Delage—just put up a new record, being flown at 206 miles per hour with a 300-horsepower Hispano-Suiza motor. This new model must, however, still be capped a biplane, but the lower plane is so small as to be quite insignificant. It consists of a very reduced surface, one meter square, affixed between the two landing wheels. The upper plane has a span of 8 meters and a breadth of 1 meter and 50 centimeters; the fuselage measures 6 meters and 50 centimeters, and the whole machine when ready for flight weighs 950 kilograms. The latest type of monoplane in England, the Handalula, is a radical departure from current practice, the wing being shaped like that of a bird. This machine, which is now simply called "Alula," was flown by Commander Kenworthy at Northolt Airdrome and attained a speed of 187 miles per hour. It reached a height of 3000 feet on almost its first flight. This remarkable performance was carried out with only a 300-horsepower Hispano-Suiza engine, but with a larger machine of modified design and engined by a 1000-horsepower Napier "Cub," a much greater speed is expected.

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Electrical Notes

Summaries and Excerpts from Current Periodicals

Italian Railway Electrification. — A scheme has been presented to the Italian House of Deputies which contemplates the electrification of about 3000 miles of railway at an expense of 1,200,000,000 lire. It is further reported that a private concern, under control of the Ministry of Public Works, intends to construct an electric line from Venice to Monfalcone.

Focusing Flashlamps.—Ever since the first 300-foot throw flashlamp appeared on the market, much interest has attached to the renewed possibilities of the portable electric lamp. Several later types of focusing flashlamps throwing a 300-foot beam have appeared on the market, all based on the use of the special concentrated filament bulb, the deep, optically correct parabolic reflector, and the three cells of dry battery.

Scottish Railway Electrification. — In connection with the proposed hydroelectric developments among the Grampian Hills, there has been some talk of electrifying the main line of the Highland Railway Company between Perth and Inverness. This is a single-track line which is approaching its maximum carrying capacity, and it is believed that serious consideration will be given to its electrification in the near future, especially if the proposed hydroelectric development work is carried through.

Drying Hay by Electricity.—A process of drying hay by electricity has been worked out successfully in Switzerland, according to advices to the Department of Commerce. The newly cut hay is packed in silos between metal sheets. The sheets are connected to an electric current supply circuit so that an alternating current of from 200 volts to 500 volts is passed through the hay between them. The effect of the current is to kill the microbes which cause damp vegetation to decay. From 130 kilowatt-hours to 200 kilowatt-hours are required to complete the drying process.

New York's Hell Gate Plant.—What is said to be the latest word in power plant construction has just been completed in New York City in the form of the Hell Gate station of the United Electric Light and Power Company. For a station of its rating, we learn from the *Electrical World*, its construction was completed in a remarkably short order, four turbines, with a combined rating of 150,000 kilowatts, having been placed in service within one year from the commencement of the steel work. The total rating of the station will be 300,000 kilowatts. The turbine room is next to the river, with the boiler room between it and the electrical galleries.

Requirements for Electrical Mica relate to dielectric strength, heat resistance and flexibility, according to a publication of the Bureau of Mines. All good electrical mica is sufficiently resistant to heat for ordinary electrical equipment and this quality is, therefore, rarely specified. Specifications for dielectric strength vary for different uses and with different consumers for similar uses. Navy Department specifications call for a dielectric strength of not less than 25,000 volts for each 1/64th-inch thickness. Mica has such a high dielectric strength that failures most common occur in defective spots. It is very important, therefore, in selecting material where high dielectric strength is required that the mica be given a careful visual examination so that all defective sheets may be rejected.

Railway Electrification in Chile.—The Nitrate Railways Company, a British corporation operating the principal railway system of the Province of Tarapaca, is planning to go ahead with the electrification of the Iquique-La Carpas section — a stretch of about 17 miles with heavy grades. The proposed work was covered by a contract made between the Nitrate Railway Company and the Chilean Government in July, 1921. Although this contract has been declared void by the Chilean Congress, representatives of the railway state publicly that so far as the company is concerned the contract is in full force and effect. The preliminary estimate of the cost of the work is £2,000,000, and an engineer has arrived from England to work up the necessary technical data for the preparation of detailed plans.

The Largest High-Tension Circuit Breaker was recently shipped to the Pacific Coast for the Mt. Shasta development. The breakers were built for the 220,000-volt Mt. Shasta development and are for use on a 220,000-volt system having a solidly-grounded neutral. The breaker is good for a 350-kilovolt wet test. The gross shipping weight of the breaker, including oil, is 90,000 pounds, or 45 tons. The net weight of the unit, erected on foundation, is 75,000 pounds. The breaker requires 2000 gallons of oil for each pole and the net weight of the breaker, exclusive of oil, is 30,000 pounds. The height of the breaker from the ground to the top of the bushing is 17 feet 6¼ inches, and its height from the ground to the top of the tank is 9 feet 8½ inches. The long diameter of the tank is 8 feet, while its short diameter is 5 feet 8 inches.

Electrical Ventilation.—There has appeared on the British market an ingenious apparatus for supplying a constant stream of fresh warm air to the interior of a building. It is claimed that those who use it will not only escape drafts, but have the pleasure of living in an even atmosphere. It seems worth trying not only from this point of view, but because it gives no obnoxious fumes or smells. The whole apparatus is strongly constructed in sheet iron, which is finished artistically to comply with various forms of decoration. The height is 4 feet 6 inches, and the base measures 13½ by 10 inches. The electric model is fitted with four electric heating units with regulating switches adjusting the consumption from 0.5 to 2 kilowatts per hour. It is stated that from 2,000 to 5,000 cubic feet of fresh warmed air are induced hourly by convection.

Railroad Electrification in Southwestern Switzerland.—The next lines of Swiss Government railroad to be electrified, in pursuance of the policy inaugurated during the war, will benefit particularly the southwestern Cantons of Switzerland, Geneva and Vaud, according to a statement in *La Suisse*. The general management of the Federal railways has just prepared a new program of the sections in these Cantons on which electrification work will soon be undertaken. These are: Geneva-Lausanne (40 miles), the sole connecting link of railway between Geneva and the rest of Switzerland; Lausanne-Vallorbe (30 miles); Daillens-Yverdon (14 miles); Lausanne-Palezieux (16 miles). In addition to this network, of which Lausanne is the center, the program includes the lines Zurich-Olten (45 miles) and Berne-Palezieux via Fribourg (60 miles). It is anticipated that the work will be finished by the end of 1927 and that, with the electric locomotives necessary, it will cost 250,000,000 francs. The date on which work will begin is not stated.

What We Learn from Forty Electrical Fatalities.—Under the heading of "Lessons Learned from Forty Electrical Fatalities," E. S. Whiting of the Liberty Mutual Insurance Company, has written a paper in which he considers hazards from low-voltage as well as from high-voltage circuits, asserting that a remarkable number of low-voltage shocks—that is, shocks where the voltage was under 600 and even as low as 110—have proved fatal. The safety engineer, says Mr. Whiting, is interested in the medical question of how electricity kills only as a possible clue to determine what maximum flow of electricity through the body is safe, but this value would be of little actual use if it were known. It is necessary to measure the electrical hazard in terms of voltage since the shock current which flows in case of accident can never be known. It is undoubtedly the amount of current sent through the body and the time it flows that causes the death, but there is no way of tying the voltage and current together quantitatively in shock cases. This is because the other element in the case, the resistance of the shock circuit, is widely variable. This resistance depends on what manner of body contacts are made with the circuit and these contacts range all the way from a light finger contact with foot contact through dry shoes (thus giving extremely high resistance in the shock circuit) down to a heavy grip of the hand on a switch blade with feet soaking wet in a pool of water (thus giving the other extreme of low resistance in the shock circuit).

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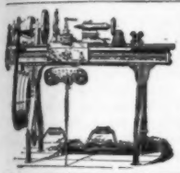

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Skilled Hands, or Automatic Machinery?

(Continued from page 151)

ital, at the same time placing in the hands of the great capitalists a weapon which they will be tempted, at least, to use unfairly?"

"It is undoubtedly the fact that the automatic machine causes a tendency toward large combinations of capital," said Mr. Leavitt. "That is one of the conditions to which we shall have to adjust ourselves. In that case, mind you, it is not the automatic machine which is to be blamed, but human nature, and the thing to do is not to take away the incentive of private gain or scrap the machines, but to regulate the activities of individuals or combinations which might abuse the advantage placed in their hands. The automatic machine in itself is a great blessing to every man, woman and child. The fact that it can be misused is no argument against it. It only emphasizes the fact that our lawmakers and enforcement officers ought to be fully alive to the possibilities in this new industrial agency."

On the train, headed back for New York, it occurred to us that if Mr. Leavitt had taken a little more sensational view of things we should have had a livelier story to tell. If only he had blamed the war on the automatic machine and added to that count the social hysteria of these turbulent days!

But somehow his calm view was reassuring. We took away the impression that a great many of us have been unduly exercised over the situation, which is evidently only one phase in a long period of transition, and, viewed from the calm standpoint of a man who had done a great deal toward bringing that condition about, gives every evidence of righting itself.

And is the manual skill of the workmen of a quarter century ago disappearing? Well, possibly! But what of it? Is not that, too, just one of the changing phases of the larger problem? Not one civilized man in thousands can duplicate the trick, which our remote ancestors could without exception perform, of making fire with a couple of dry sticks. We have forgotten this trick because we have no longer any need for it, and we are none the poorer in any sense for the substitution of matches and electric switches. Is not the substitution of machines for skillful manipulation in our industries just another case of the same sort?

The big point is that the man who is endowed with natural mechanical ability, the man who toils at the bench, at the forge, or at the machine in the factories, has a better chance today than ever before to enjoy as the fruits of that toil a happy, useful life. Take it as the word of a man who has been successful in that philosophy.

Or blame it on the automatic machine, if you like!

The Seventy-Five Mile City

(Continued from page 157)

motion pictures in Los Angeles, and paper in Maine.

When the War Department was looking about for possible purchasers of the Muscle Shoals property, Mr. Ford visited the place at the Department's invitation. He saw at once its practical possibilities in connection with his pet scheme. It was then that he first allowed the "New City" which he had in mind to nail itself down to a definite location. The Muscle Shoals territory spelled to him a huge industrial development based upon the use of hydro power in the production of cheaper fertilizers for the farmer, cheaper aluminum ware for the housewife, and cheaper cotton goods for everybody. This is in fact the combination dictated by the natural advantages of the region, and the region is in fact the place of all places for such a development.

For 75 miles the waters of the Tennessee River flow between high flint-limestone banks, and over a solid limestone bed already tested by nature for seepage under high pressure. By building a series of power dams along the stream and impounding dams further up in eastern Tennessee where the mountain formation is favorable to the creation of artificial lakes, it would be possible to obtain over a million horsepower without a too-great variation between primary and secondary voltages. Just to the north, in Tennessee, lie partly developed beds of phosphate rock and untouched vast fields of dolomite. Less than a hundred miles to the southwest are large untouched bauxite fields. Directly south lie the brown hematite and the stratified red iron-ore of the Birmingham district.

Going still further into detail, we find that

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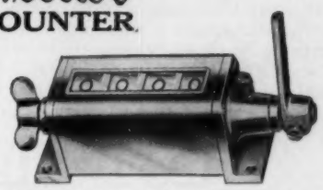
The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.



The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

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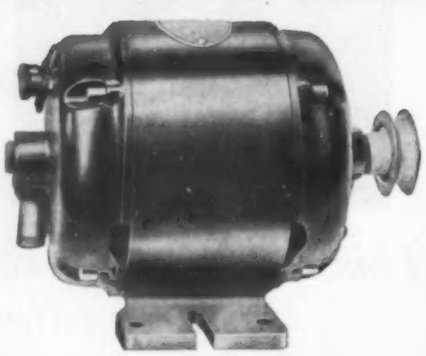

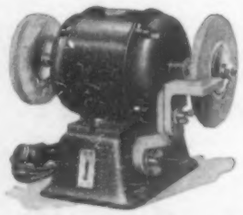

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when completed, the now one-third-finished Wilson Dam will throw back the waters 15 miles over the rapid Shoals to the Upper dam. This second concrete monolith, though not so high as the Wilson barrier, will by virtue of the less steep run-off of the river affect the stream for nearly 50 miles east and north. The two great inter-connected power dams, with their locks for navigation, will create a fresh-water lake about 70 miles long and varying in width from three miles to less than a mile. Along this body of water and its tributaries Mr. Ford would establish his electric furnaces and fertilizer factories. If they were used at all, the present nitrate plants, No. 1 (Haber process), five miles below the Wilson Dam, and No. 2 (cyanimid process), at the dam, would simply be units in a mighty chain of fertilizer industries extending up both sides of the long lake; for Mr. Ford's idea is to produce concentrated plant food in hitherto unrealized quantities.

In support of the agricultural features of the scheme, it may be stated that for many miles along the river and for a good distance back of it (especially on the south side) the land is rolling and with sufficient slope for natural drainage. The firm clay sub-soil, free for the most part from rocks or gravel, retains well both fertilizer applications and moisture. It is a soil that readily responds to "building up." And in this connection, fertilizers from the factories will be low in price and will carry no freight-charge burden. The present products in the valley are cotton, corn, winter grains, cattle and hogs. When limed the soil yields fine cuttings of alfalfa and white and red clovers. Rainfall is about 50 inches a year, fairly well distributed through the months. A real drought never occurs. The valley is free from malaria. The water supply is from hill and mountain springs and the clear waters that flow therefrom.

It is difficult to write of this project in terms sufficiently conditioned to make it clear that after all it is as yet only in a stage where there is no certainty of its attainment. So with this apology, perhaps we may be permitted to substitute the more vigorous "will" for the colorless "might," "could," "would," and "should." Out of the thousands who will have a part in this great effort, many will fall short, of course. This is natural and inevitable. But under a system, with continued, capable instruction, and prizes and bonuses for best results, there is no reason for a large number's not making good; some fully and others to a limited extent. There certainly will be opportunity for salary earning simultaneously with home and land ownership and soil production that otherwise would be wellnigh impossible no matter how carefully wages might be saved. Those who are seeking something for nothing or looking to get ahead without hard work will be weeded out automatically. Their places will be taken by others who are anxious to make continued, sincere effort and who are ambitious to make something of themselves and for their families. Even a few of these may fail from one cause or another, but in time a new and trained generation will come into existence.

A large agricultural and industrial school will be established in the valley, somewhat on the principle of Mr. Ford's trade school at Highland Park in Detroit. Boys studying agriculture will learn under actual field conditions. Their labor with the crops and livestock will be to produce for a profit so that they will receive this profit for their work. They will build the chicken houses, hog pens, barns, fences, etc., on the instruction farm. They will take care of and repair the machinery used. In the manual training department they will not play at making useful articles—they will make them to be sold for profit; such as chairs, tables and other furniture, small motors, radio sets, etc. All work will be along strictly utilitarian lines, the boys receiving reward in money, as well as knowledge and experience.

It will be much the same way with the girls and women seeking instruction and training in home-making. While they are getting experience in canning and preserving they will can and preserve vegetables and fruits for use in their own homes or for sale in the markets. In the garment-making department they will fashion and sew clothing for their own wear and for their mothers and sisters. In this new sort of intensely useful training institution to be established, the principal method will be to work to a definite purpose with definite, profit-making or money-saving results.

The completion of the two dams will create hundreds of miles of waterfront along the rivers and creeks that flow into the Tennessee River. With water transportation all the way down the Tennessee to the Ohio and on down the Mississippi, hundreds of farmers in other parts of the South and through the Central West are planning to locate in the Muscle Shoals district. They are coming not to work in the factories, but to farm independently and produce for the market wheat and corn, cotton, vegetables, dairy products, hogs and cattle. Cheap fertilizer right at hand and economical marketing facilities make a strong appeal to them, as their visits and letters to the Shoals district clearly show. Meanwhile native farmers in the valley are looking forward eagerly to the construction of the dams and the opening up of the great river to navigation. Most of the cotton and corn raised in the valley above Wilson Dam will be shipped down the river-lake on barges direct from neighborhood warehouses and cotton gins. This will effect large savings in freight charges, as these farmers well realize. The plan is later to open up the river for navigation all the way from Knoxville to New Orleans.

Factory and farm close together, yet cooperation between them; satisfying and lasting opportunity to tens of thousands of capable, ambitious workers—this is Mr. Ford's purpose and plan for his employes in the Tennessee Valley industrial operations. And his aim and plans for farmers all over America is to supply them with concentrated fertilizers at lowest possible prices so that American yields of cotton, corn and wheat per acre may be increased without increased cost to the farmer, but with larger profits to him. Increasing cotton yields a quarter of a bale per acre and corn production five bushels per acre would result in additional annual wealth to farmers, and the whole people, beyond the comprehension of the average man. As immense as it is, the automobile business would be a pigmy beside it. And cheaper fertilizers, shipped in concentrated form, will make it possible if not probable in time.

46,000 Miles of Good Roads

THE $350,000,000 appropriated by Congress as Federal aid in conjunction with State funds will result in the construction of about 46,000 miles of road, says the Bureau of Public Roads of the United States Department of Agriculture. This mileage would parallel the railroad from New York to San Francisco nearly 15 times, or, if divided equally among the States, would give nearly 1000 miles to each State.

The status of road building on April 30 was as follows: In projects entirely complete, a total of 16,375 miles; under construction, 13,950 miles in projects, averaging 62 per cent complete. A considerable part of the latter mileage is actually complete and in service. In addition, funds have been allotted to 7511 miles, much of which will come under construction during the present season. Besides this there is still available for new projects $60,148,000, which on the same basis as previous Federal aid construction will result in the construction of 8200 miles of highway. In March the fund available for new projects was taken up at the rate of $12,000,000 a month.

Extensive Drives Against Jack Rabbits

A TOTAL of 683,800 jack rabbits killed is reported by the Biological Survey of the United States Department of Agriculture, as a result of jack-rabbit campaigns this spring in Utah, Oregon and Washington. The figures are based on very close counts by farmers and other interested persons and are considered conservative. Probably a great many more rabbits were killed than were actually reported. In the Goose Lake Valley, Oreg., while the actual kills of rabbits were not large, the saving of future crops was very important. This is an irrigated district that is coming into heavy production, and the rabbits do a great deal of damage. More than 278,300 rabbits have been destroyed during the Oregon campaigns.

In Boxelder County, Utah, extensive operations were carried on in five communities, and practically every community that undertook the work in a systematic way obtained very satisfactory results. More than 250,000 rabbits were killed in this county alone. In checking up the central Washington district a total of 155,500 rabbits were reported in six counties as having been killed between November and February. This is the most successful campaign ever conducted in the State.

Ectoplasm and Ectoplasm Fakers

(Continued from page 162)

in a short time in a further state of development. The same thing happened in reverse on dematerialization. Too much happened behind the curtain. It seems a pity that Dr. Geley did not hold on to the hair as he had his fingers in; he might have found Eva in the neighborhood.

Baron Schrenk-Notzing's experiments were conducted in a similar manner to Geley's, and showed like phenomena. On one occasion when Eva was searched before entering the cabinet there was a marked diminution of phenomena, both in kind and degree. Two spirit faces, phosphorescent in appearance, were seen hovering near the cabinet, and a small blob of ectoplasm on the lips of the medium. One of the observers took a flashlight photograph of the latter and on development the plates showed them to be photographs of two well-known men, touched up with luminous paint to give the spirit-like effect.

The British Society for Psychic Research invited Eva Cariere to London to demonstrate her mediumship. At a seance under the auspices of the society Eva was subjected to searching tests, and rigid conditions. Before entering the cabinet she was thoroughly searched, and the cabinet was also thoroughly investigated. Nothing of a contraband nature was found. Eva went into a trance and produced—absolutely nothing, neither heads, faces nor ectoplasm! Eva blamed the London atmosphere! It seems pretty well established that if Eva takes no "props" into the cabinet nothing out of the ordinary happens. Briefly stated—no search, spooks; search, no spooks.

With such strong presumptive evidence of fraud on the records, and as no psychic researcher can be more reliable on psychic matters than his medium, it will be well to look into Eva Cariere's record. As far as can be ascertained she was born in the south of France as Marthe Beraud, and for some years practiced there and in Algeria as a clairvoyant and medium under that name. She finally attracted considerable attention by means of many demonstrations new and extraordinary, especially her extrudations of ectoplasm. Eugene Marsaut, a French notary and member of the French Society for Psychical Research, decided to investigate her. He made no effort to prevent fraudulent methods being adopted by the medium if she so desired, but during the manifestations he turned a flashlight on the operations and Marthe was caught red-handed. Her spirit faces were just "props," her ectoplasm nothing more supernatural than gossamer veiling and a disgusting mess of regurgitated albuminoid matter. M. Marsaut obtained a signed confession that her whole gamut of spirit and ectoplasmic manifestations was produced by fraudulent means, and a record of the frauds and exposure is to be found fully set forth in the proceedings of his society.

Marthe Beraud's debacle occurred in 1914. She returned to France, laid low for a time, then came forth from her retirement under her present name, to fool all and sundry down to date. Such is the story of the medium, on whose manifestations and integrity the scientific evidence of Geley and others in favor of the reality of ectoplasmic manifestations rests itself. Preserve us from such science!

There are other notable producers of this ectoplasm. Einer Neilson created a stir in Stockholm until the Norwegian Society for Psychical Research investigated his claims. At a seance under the observation of members of the society the usual phenomena appeared, but one of the investigators had no fear of the dangers of ectoplasm, so during the extrudation took a chance on it dissolving or being reabsorbed. He turned a flashlight on the medium. The investigation showed that the ectoplasm of Neilson was nothing more than shreds of silk gauze which he alternately swallowed and regurgitated. The records of the society afford proof of the fraud of the ectoplasm investigated upon this occasion.

Another medium of wonderful power and attainment is Ada Bessinet, of Toledo, Ohio, who produces practically every phenomenon known to psychic science — spirit faces, voices, levitations and so forth. The means she employs are "ectoplasmic soul exteriorizations," which no doubt is quite all right —if you know what it means. The British College of Psychic Science arranged a series of seances under the direction of Mr. J. H. Mackenzie, the principal of the college. Miss Bessinet is a very sensitive medium, and can produce her phenomena in absolute darkness only. In one seance, not being searched, and seated unfettered on a chair, she produced the usual spirit heads, faces, voices and lights; all in the immediate vicinity of where her hands and head were likely to be. Then when her hands were shackled she still produced phenomena, but in a more limited area and of fewer varieties. In another test the possibility of fraud was further narrowed by inclosing her in a cabinet with sides of ⅞-inch mesh twine net. The results were very disappointing: few phenomena appeared, and the spirit lights could not get more than an inch or so from the net. Next seance the medium was searched thoroughly and placed in a cabinet which had been searched also. The results were negative: thorough investigation killed these as other spirits.

In the final seance, however, really wonderful things happened. Miss Bessinet was not searched, wore her own clothes, and no effort was made to prevent her indulging in fraud. One of her controlling spirits kindly tied her to a chair and she drifted into a trance. Very shortly the usual voices and faces were in evidence, and roamed much farther than the medium could do, as she was tied to the chair. After a time one of the spirit faces, wonderfully clear and radiant with an ectoplasmic light, slowly approached the table at which the investigators were sitting, and seemed to be hovering in the darkness quite close to one of them. This was considered a suitable time for a close investigation, so Mr. Mackenzie flashed a light. Once more Geley's absorbing and Crawford's dissolving theory regarding ectoplasm received a severe jolt. The light revealed the "ectoplasmic soul exteriorization" as the very material Bessinet herself, her right hand resting on the table, her body leaning forward toward one of the sitters, and in her left hand a small electric torch turned toward her face provided the ectoplasmic light. Gossamer draperies around her head enhanced the spirit-like effect. An inspection of the rope and chair showed that the "spirit" who tied the medium knew all about slip hitches, for he tied Bessinet with one that enabled her to free herself quite easily. An electric indicator showed that while she was supposed to be tied safely to the chair she had been free and standing more than half the time of the seance.

Space forbids the mention of the scores of other instances of plain fraud in the production of spirit phenomena, but in investigations extending over more than 20 years the writer has yet to meet with a medium whose manifestations have stood the test of critical examination. The most useful apparatus that can be used in psychic investigations is simply constructed—just a plain flashlight.

A remarkable aspect of this research is that when a medium is detected in the act of fraud so many psychists refuse to accept the evidence as being against the medium. It is the spirits who are blamed. Eva Cariere (née Marthe Beraud) Einer Neilson and Ada Bessinet are still high in the esteem of many noted spiritualists, although they must know their respective records. It seems that when the psychic "scientists" wanders into the spirit realms he leaves behind him his keen, critical mind, taking with him one childlike in its simplicity, and a will to believe anything he sees and all that is told him. To make a careful study of the circumstances and the nature of the phenomena, with reference to causes other than psychic, seems to be considered neither wise nor necessary nor even fair. Ordinary rules of evidence are discarded and new ones, peculiar to spiritism, are adopted. In place of the desire to make an open-minded search for the truth we see an absolute determination to get psychic results and verify the spiritistic claims.

There is too much of the "hole and corner" method in the psychist's investigations; too much darkness, and a disregard for intelligent investigation that places the whole business in a ridiculous position when viewed by men who are accustomed to weigh evidence. Careful consideration of the evidence for and against the reality and truth of ectoplasm forces the critic to pronounce it a fraud. That wriggling, wormlike, reptillian mess, that caused Conan Doyle to shudder when he touched it, is as disgusting in the manner of its production as it is doubtful in origin. Ectoplasm, the foundation of present-day spiritism, being fraudulent, one should see the superstructure fall of its own weight—but it will not. The spiritist loves his idol. Its feet may be of clay, but its head is ectoplasm, so do not shatter or dissolve it. The will to believe is what keeps the whole fraudulent business in vogue—not the evidence, for there is none that can withstand critical analysis.

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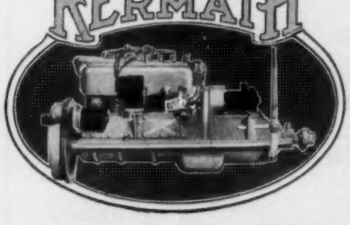

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Taking Aeronautical Photographs From the Ground

(Continued from page 169)

the blurring effect of motion, and it is an established axiom of photography that a picture taken by means of a quick exposure can never have the detail and depth of focus that is to be attained by means of a longer exposure through a smaller aperture of the camera diaphragm.

The preliminary tests with the aerograph have been conducted by towing the captive balloon about with a small automobile, or by deflating it for transportation, and re-inflating upon the scene of operations. This costly, and unsatisfactory method, however, is soon to be discarded in favor of a specially constructed motor truck which to all intents and purposes will be virtually a perambulating hangar. When inflated the balloon is but 30 feet in length. The hangar-truck is therefore being built upon moving-van lines, so that the balloon may be pulled down and housed within it for transportation to any desired scene of operations. The body of this truck, even with the balloon housed inflated within it, will come within the legal requirements limiting the bulk of motor vehicles. It will be low enough to get under all wires, trees, and obstructions over public highways. The truck will also carry a windlass for raising and lowering the balloon, the instrument control and indicator board, and a hydrogen generating plant for inflating the bag.

Up to the present time hydrogen compressed into steel cylinders has been used for inflating the balloon. By this method the cost of inflating the balloon is about $15 for each inflation, and by actual tests it has been demonstrated that the bag will hold a working charge of gas for a period of 30 days. The installation of the hydrogen generating plant on the motor truck will further cheapen the cost of inflating the balloon, and the truck itself by enabling the operators to retain each charge of gas while transporting the outfit about the country from job to job, ready to go to work, will reduce all operating costs to a minimum. It has cost many thousands of dollars to develop and perfect the first aerograph outfit to its present stage of efficiency. If manufactured commercially the entire outfit could probably be marketed at a cost of not to exceed $2500. On this basis the cost of aeronautical photographing simmers down to a comparatively modest investment for equipment, a low overhead, motor truck transportation to and from various jobs, and the normal expenses of ordinary ground photography. When we compare this with the expense of producing inferior aerial photographs with the present almost prohibitive cost of operating aircraft figured into the price of the finished product it is evident that the advantages gained by producing such photographs entirely by mechanical means have a pecuniary appeal to make the widespread use of such photographs profitable. Indeed, the physical limitations of man-carrying aircraft have made the production of many desired aeronautical photographs utterly impossible. On top of this the cost of operating aircraft to and from the job, risk to the operators, aeronautical insurance at a high premium, the usual costs of photography, and a long list of incidental expenses, have been determining factors in keeping the cost of photographs made from the air from "getting down to earth" at a price to put them within reach of any but a prosperous few. Heretofore the cost of production of aerial views has been in excess of the value to the prospective user in the vast majority of instances, and for that reason alone the widespread use of such pictures has been largely precluded. It is therefore only reasonable to suppose that with the production of such pictures brought down to a nominal figure by means of the mechanically-controlled captive balloon method of production, that such photographs will be used in the near future by unnumbered firms, individuals, and corporations, who heretofore have been denied the advantages of such pictures.

The Sydney Harbor Bridge

(Continued from page 181)

duced by a violent hurricane capable of uprooting large trees. The main piers will be 175 feet high from their foundations, and measure about 144 feet wide by 37 feet thick at the top. The foundations do not present a very serious engineering problem, since solid rock occurs about 15 feet below ground level. It is proposed to carry the foundations about 18 feet into the rock. The foundation area of each pier will be about 6000 square feet. They will be constructed of concrete faced with dressed granite blocks.

The anchor piers will be about 110 feet high from lowest foundation level in the rock. At a low level there will be embedded massive steel girders to which will be attached vertical steel links for securing the ends of the anchor arms and preventing them from lifting.

It is assumed that two of the railway tracks will be loaded each with a train consisting of two electric locomotives weighing 160 tons each, and 16 cars of 62 tons each, occupying a length of 1000 feet. The other two tracks will each be loaded with a train weighing one ton per lineal foot. The footwalk and roadway loadings will be 100 pounds per square foot. All these are known as the "live load" and make up the 6½ tons per lineal foot already referred to. This loading, however, does not apply to the whole length of the bridge, but only locally. The load per lineal foot taken on the whole length is considerably less. As may be supposed, a rapidly moving load produces more serious stresses than the same load would produce if stationary, and due allowance is made for this fact.

Although the stresses produced by the live load, wind pressure and weight of steelwork are the greatest, there are stresses produced in other ways that have to be allowed for. These are the effect of the braking of trains, torsion due to unequal loading on the two sides of the bridge, temperature variations, and stresses in joints caused by friction and bending.

There are two ways in either of which the bridge may be erected. One is to build temporary supports between the main and anchor piers and on them to erect the two anchor arms. The river arms would then be built out, a panel at a time, as cantilevers. The 600-foot center span would be built alongshore on pontoons, floated out, and lifted by hydraulic rams from the pontoons to the ends of the cantilever arms by which the center span will be permanently supported. Alternatively the center span would be built out from the ends of the two river arms as extensions until the two halves meet in the middle, where permanent connections would be made, the temporary ties to the ends of the cantilevers being then removed. The other method of erection would be to build out the cantilever and anchor arms from both sides of each pier so that they balance, first building up temporary piers between the main and anchor piers to provide stability against overturning.

Although the general design of the bridge has been prepared, it is left to the contractor to work out details. The quality of steel has not yet been decided upon, but probably nickel steel or chrome nickel steel will be largely employed, since its tensile strength is about 40 per cent greater than that of mild steel. The estimated cost is £6,000,000, and the time for completion from commencement will be limited by contract to seven years. The engineers are to be congratulated on the excellent manner in which the specification has been drawn up. Its conditions are such that the best brains in the world will be brought to bear on the design.

Compare this with the recently proposed bridge across the Hudson River, comprising a central clear span of the enormous length of 3240 feet, with two side spans of 1710 feet each. In this case the weight of the live load in proportion to the weight of the structure would be such that the objections to the suspension type for smaller spans practically disappear. We are given to understand that the suspension cables would be braced, and the roadway platform hung from them as usual. The anchor piers would measure 400 feet by 375 feet at the base. The two main towers would rise to a greater height than the famous Woolworth Building (New York). In fact, the amount of masonry involved has been compared to that comprised in the pyramids of Egypt. As projected, the bridge would be 220 feet wide, the platforms being suspended from four steel chain cables, each comprising 80 links of eyebars in three tiers, inclosed in a bronze plate casing 15 feet in diameter. The upper platform would carry two trolley tracks, two 17-foot walks for pedestrians, and a roadway 155 feet wide, capable of accommodating 16 lines of vehicles abreast. The lower platform would support 10 main-line railway tracks. If constructed, the Hudson River bridge would have a clear span double that of the Sydney Harbor bridge, and would, indeed, be a conquest in steel.